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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

A New Steam Pump.

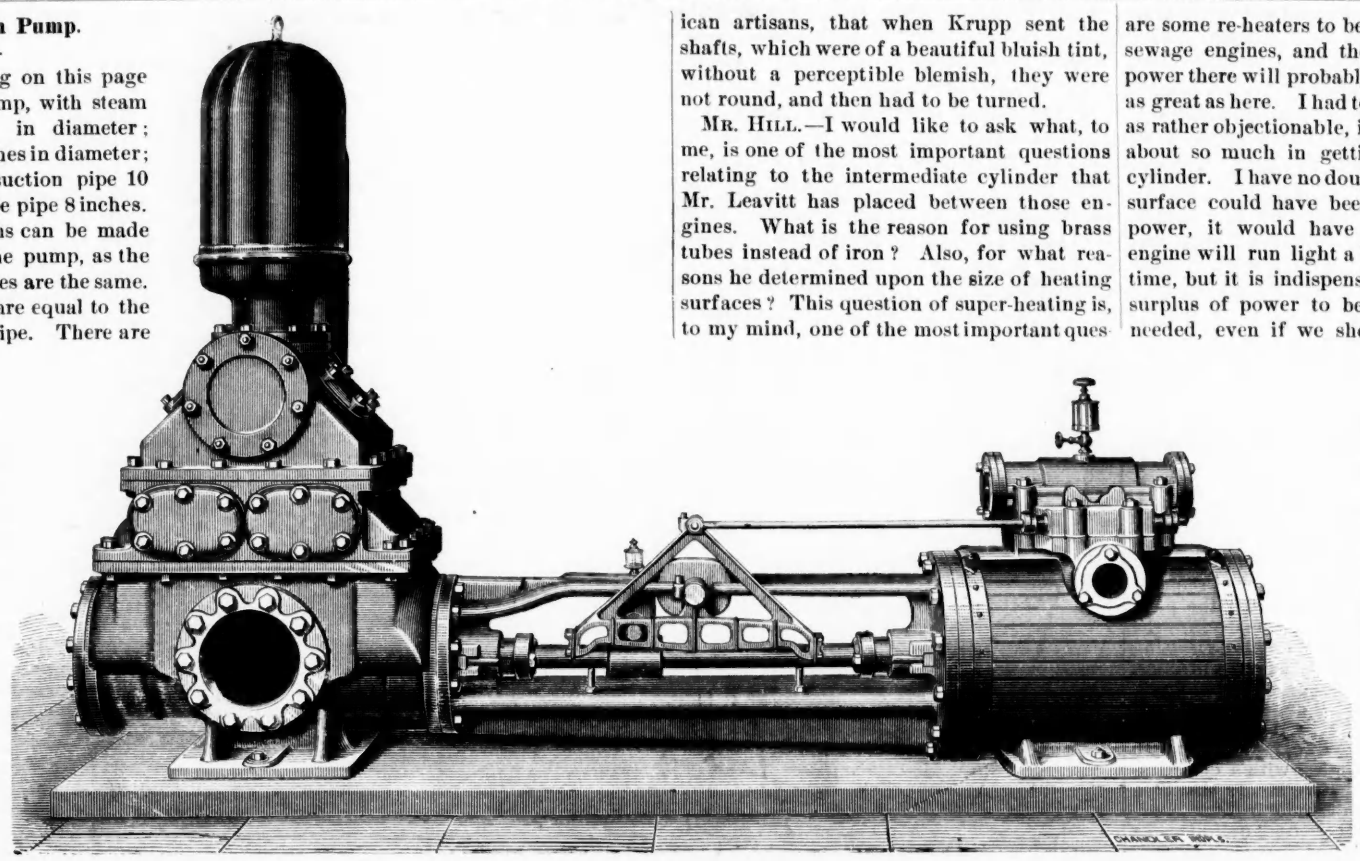
The first engraving on this page represents a new pump, with steam cylinder 18 inches in diameter; water cylinder 12 inches in diameter; stroke 24 inches; suction pipe 10 inches; and discharge pipe 8 inches. The pipe connections can be made from either side of the pump, as the openings on both sides are the same. The water passages are equal to the area of the suction pipe. There are eight rubber valves each eight inches in diameter, which can be examined or taken out by removing the hand hole plates.

The steam valve arrangement is a new and simple feature. The piston rod carries a projecting roller which moves between the flanges of the rocking cam. When the main piston approaches the limit of its stroke, the roller passes between the curved flanges near the end of the rocking cam, causing it to swing and move the auxiliary steam valve, reversing the motion of the main piston. As the roller starts on the return stroke, it rocks the cam back to its first position and brings the auxiliary valve on its center or to mid-stroke. The object of giving this motion to the auxiliary valve is to keep its steam ports closed, except during the instant the motion of the main piston is being reversed, and thus prevent loss of steam in the steam chest in case the chest piston becomes worn and leaky. Nearly all direct acting steam pumps, in time, will leak steam into the exhaust pipe, in consequence of the wearing of the chest piston. The cutting action of the steam "blowing through," greatly increases the leak.

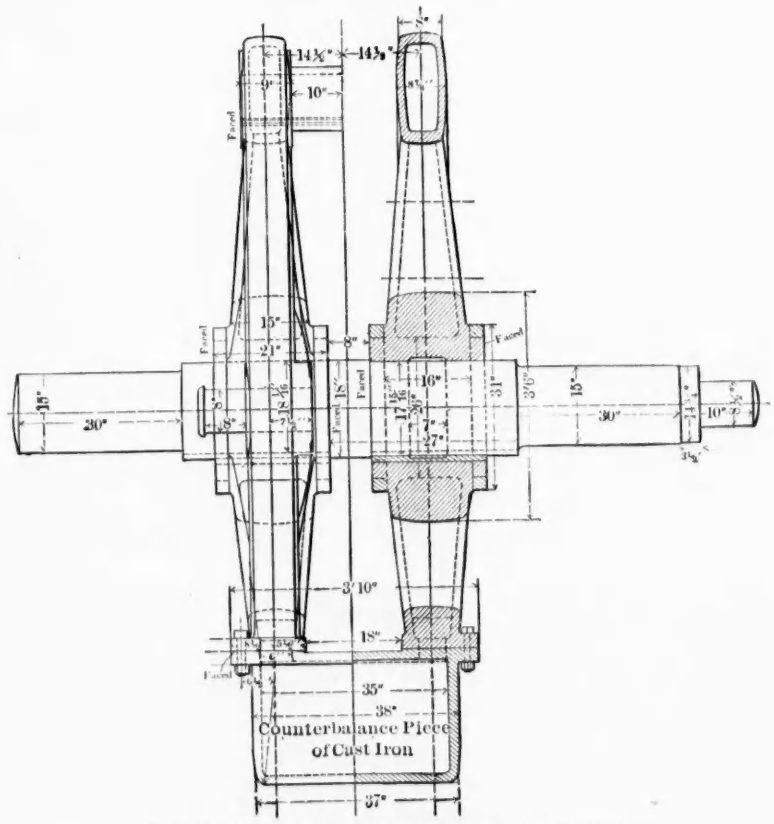
In this pump the chest piston is plain, without steam ports of any kind. It is of little consequence whether the chest piston is leaky or not, there being no place for the steam to waste by "blowing through," as the cam motion brings the anxiliary valve to its mid stroke, keeping the passages leading to chest closed, except during the instant the main piston is being reversed.

These pumps are made in twelve sizes, from 3-inch to 20-inch steam cylinders, and from 1¾-inch to 14-inch water cylinders.

In action, this pump is smooth and virtually noiseless. It is capable of being worked at a high speed without increasing danger of injury. It is manufactured by Dean Brothers' Steam Pump Works, Indianapolis, Ind.



A NEW STEAM PUMP.



SECTION OF BEAM WHEELS OF THE "SUPERIOR."

The plan of laying telegraph wires in terra cotta pipes in public sewers, has been tried in Washington, D. C., and works well. The wires are run down the poles to the ground and gathered into a cable.

The Superior.

DISCUSSION ON THE PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BY E. D. LEAVITT, JR.

(Referring to paper published in last issue.)

After the conclusion of his paper, Mr. Leavitt mentioned, for the benefit of American artisans, that when Krupp sent the shafts, which were of a beautiful bluish tint, without a perceptible blemish, they were not round, and then had to be turned.

MR. HILL.—I would like to ask what, to me, is one of the most important questions relating to the intermediate cylinder that Mr. Leavitt has placed between those engines. What is the reason for using brass tubes instead of iron? Also, for what reasons he determined upon the size of heating surfaces? This question of super-heating is, to my mind, one of the most important questions we are likely to deal with in the future; and all the points that will help us in that direction seem to me most valuable.

MR. LEAVITT.—The reason for using brass tubes is, that we can get them $\frac{1}{32}$ of an inch thick, and they are not as likely to fur up; as regards the quantity of heating surface, I got all I could in given dimensions; I did not want to make the receiver too large. There are some re-heaters to be used on the Boston sewage engines, and the surface per horse power there will probably be about five times as great as here. I had to do what I regarded as rather objectionable, in twisting the steam about so much in getting it to the L. P. cylinder. I have no doubt at all that if more surface could have been applied per horse power, it would have been better. The engine will run light a large portion of the time, but it is indispensable to have a large surplus of power to be drawn upon when needed, even if we should not use it more than half an hour per day.

The reason for departing from the original construction of placing the cylinders near together, was to obtain room for the re-heaters, whose principal value will occur when the engine runs light.

MR. STIRLING.—I am glad that attention has been called to the advantage of a receiver between the boiler and engine. I think that we lose a great deal of our power by not maintaining the boiler pressure on the valves of the engine. I think it is very important, where steam is carried any distance at all, to have a receiver near the engine—near the valve chest. I failed to notice, as the paper was read, the maximum amount of horse power. I would like to ask how much that was; and in relation to the amount of heating surface given in the boilers, I notice that the "Gallia" of the Cunard Line has 13,000 feet of heating surface, and indicates over 5,000 horse power, which is an allowance of 2½ square feet of heating surface per horse power. And I would like to see how this engine compares with that. That seemed to me to be remarkably low. I would like also to ask Mr. Leavitt—incidentally he made the remark that the valve shafts had to be very rigidly supported on the foundation—I would like to ask him the reason of that, and if he has made any arrangements for balancing the valves of this engine.

MR. LEAVITT.—In regard to the proportion of heating surface, it was made large in order to secure a high evaporation. The maximum power, when cutting off at half stroke in the high pressure cylinder, with 135lbs. boiler pressure, is estimated at 4,700 horse power. The boilers are designed for 2,500 horse power. There is a possibility that we may some time in the future require the maximum for short periods, when, for instance, we get all the skips at the bottom of the mine at once. I made a calculation not long ago concerning those 70 ton drums, and found that it would require 1,300 horse power for one revolution to put them in operation at speed. As now run, the engine slackens when the drums are put on, the power being distributed over several revolutions by the *vis viva* of the fly-wheel. As the mine grows deeper, we cannot afford to

slacken speed, which must be maintained regularly in order to do the hoisting required.

The reason for rigidly supporting the valve shaft is on account of the large diameter of the cams.

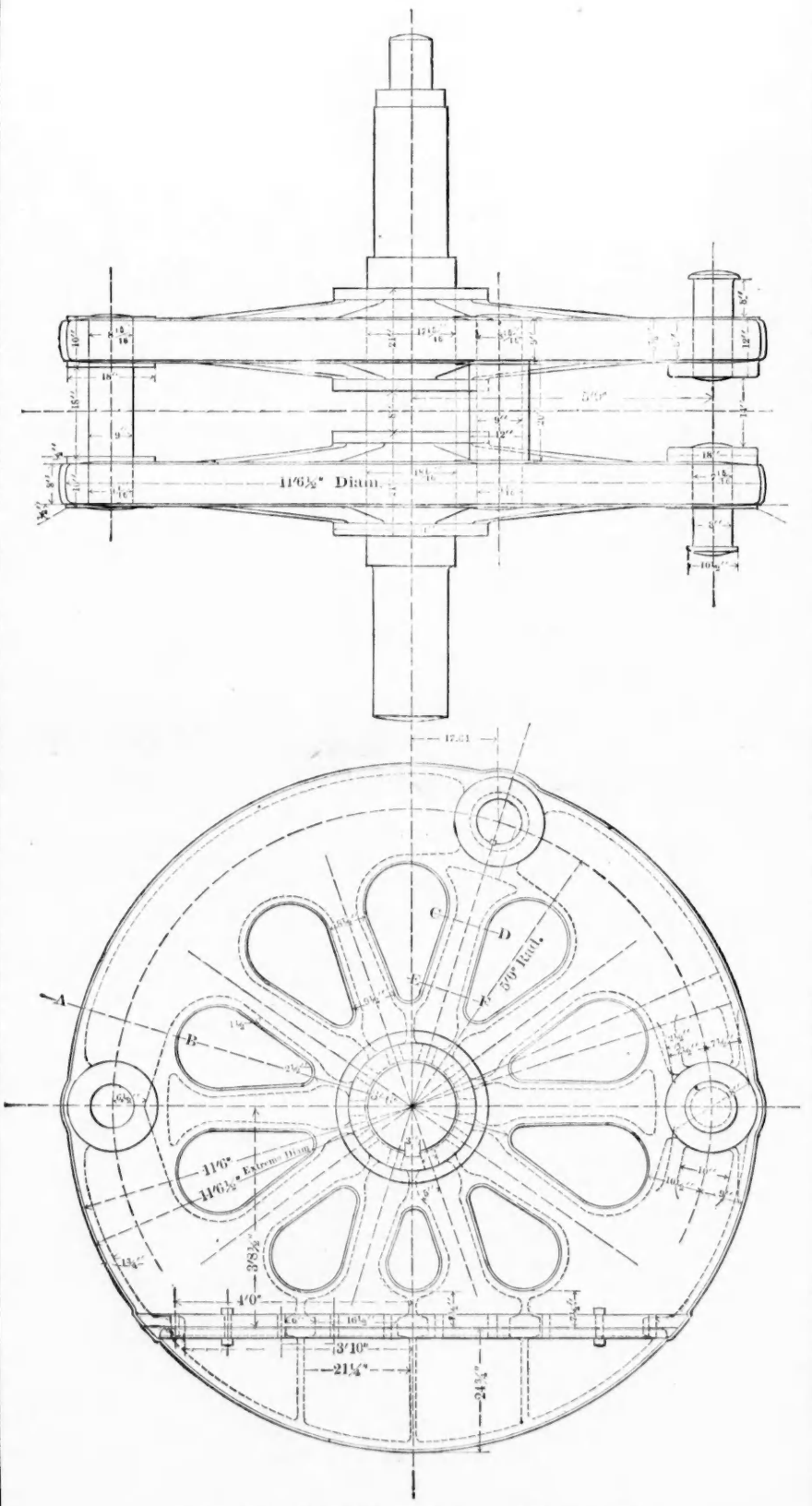
In regard to balancing the valves, I have never given that matter much thought. I know that these valves work well enough for all practical purposes; they take very little power. The movements are instantaneous, and from the size of the valve gear that we have been compelled to use thus far, I think they have worked very easily. There is machinery enough about the valve gear anyway. We do not want to get any more.

MR. EMERY.—I must say it is very gratifying to me, as an engineer, to look over plans of this kind, and see the thorough manner in which the work has been carried out. There seems to have been plenty of means to do a good job, and the proper head to do it; and those two elements, when brought together, are sure to make a success of any matter. In regard to super-heating between the two cylinders, it has been agitated for years, as is well known; and some seven years ago I made a design for an engine of large size for a manufacturing establishment, embodying this feature on an extensive scale. Mr. Weightman, here present, made the drawings for me. The proposed engine was never constructed, for a reason that some here can appreciate. It is never well, in dealing with certain classes of people, to press matters. Wait for them to come to you, rather than drive them up in "drummer" fashion. That was the view that I had. I was frequently called in consultation with the parties, and felt assured they had confidence in me. I prepared my plans, so as to be ready to talk as soon as the subject of new engines was broached. But, as it turned out in the end, somebody else wanted the work, and, by quiet, persistent drumming for a year, finally put into that establishment the oldest and simplest form of engine, with hardly any cut-off at all—a fixed cut-off, and not a governor cut-off—and that is running there to-day. The parties had the means, and, if properly guided, would probably have done something well. While the views of different engineers run in different lines as to the way the details should be put in, still the principles which underlie such matters—the method of constructing engines, getting small clearances, obtaining the super-heating, and all that—would necessarily be much alike. My views at that time, which I should not change now, were in the direction of connecting the two cylinders to the same crank shaft at right angles, with a comparatively large receiver between. In that case there is no necessity of reducing the capacity of the passage to second cylinder, as there is with the kind of engine shown by Mr. Leavitt; because, by cutting off at a proper point in the second cylinder—the larger of the two cylinders—there will be compression sufficient in the small cylinder to bring the pressure back to the point to which it is reduced by expansion in the second cylinder. All that has been done in that line elsewhere seems to show that that is as correct at least as the other form; and I think, and in fact it would almost appear to a mechanic without much discussion, that the details necessary to carry out the work are somewhat simpler and cheaper. I do not suppose, in the matter of efficiency there is any great difference. I have constructed a number of marine engines connected in both ways, and both are successful and economical, though those connected at right angles are most convenient to handle.

MR. HENNING.—I would like to ask Mr. Leavitt as to the bell crank he mentioned as having been made of cast steel; whether those castings can be depended upon, and whether they are free from blow-holes?

MR. LEAVITT.—I think we had five or six sets made to get them free from blow holes, and things of that sort, and we finally succeeded. It was put in with the idea of having that work all of steel. Cast iron probably would have been strong enough, by making it a little heavy. The principal reason, though, for making it of steel, was that we wanted to get a long connection between the eyes, and we could make of steel a great deal thinner flange than we could with the cast iron, and we would get a shorter length of bell crank.

MR. HOLLEY.—With reference to the materials, it may be a source of regret to Americans, and ought to be perhaps a source of mortification to American steel makers, that when such large constructions as this 30-ton shaft are required, we have to go abroad for them. We have not any hammers in this country adequate to the production of such large shafts, but I am quite sure of that, in view of the development of steel castings, large shafting and large forms of structural steel in every shape can be more safely made from the metal in the fluid state, and much more cheaply made, than by trusting to the forger. We know that a great many physical defects are developed by the hammer; last summer I had occasion at the Steel Works of Scotland, in Glasgow, to notice a forged steel reversing engine shaft of pretty large dimensions which had been broken. A new one was on hand so that it did not stop the works, but a steel casting had been ordered for the next one. The people at those works had been so familiar with the steel castings that they would rather trust the enormous strains of a reversing rolling-mill engine to a steel casting than to a steel forging. If it is in order, I will just say one word about this matter of improved steel castings. It is now more that twelve years since the Terrenoire Company in France began experiments which cost them certainly several hundred thousand dollars, to improve this important art. I won't go into the details, but mention that, although the manipula-



DETAILS OF BEAM WHEELS OF THE "SUPERIOR."

tions are rather complex, the general idea is pretty simple. Steel castings have been made for a long time, and when they were full enough of silicon and carbon, they were sound. There was no trouble in getting them sound enough; but when they were sound, they were never strong, and when they were strong they were never sound. But that is a problem which the Terrenoire people tackled, and they tackled it successfully. But you know a very simple result is sometimes got out by very complex and expensive experimenting. The carbonic oxide, which is the chief cause of blowholes, is undoubtedly reduced by silicon; this makes a sound casting; but then the trouble begins with reference to strength. The silica, which is then formed, remains diffused throughout the whole mass, and it cannot be strong. There is also a large amount of oxide of iron diffused throughout the mass, which also tends to make it weak. Now the silica that is left by the decomposition of the carbonic acid by silicon, is removed by fluxing it with manganese. The silica is so viscous that it will not flow out; but by mixing a suitable amount of manganese with it, it will separate itself from the mass of steel by difference of gravity; and also, by the same means, keeping the steel washed free from oxide of iron. Not being a chemist, I won't attempt to go into these chemical phenomena. Now as to the results obtained: I have the results of a very large number of experiments, not only made at Terrenoire, but at other places where this same process is used; and, in a general way, I can give you an average result of the composition and the physical character of the very hard steel, and the pretty soft steel; the soft steel being more used for structural purposes. The average of elastic limit of the hard steels is 60,500 pounds, with a breaking tenacity of 126,000 pounds; but giving only a stretch of from 3 to 6 per cent. Of course, that is very hard steel, unsuitable for many structural purposes; but a soft steel is made with an elastic limit of 30,200 to 31,000 pounds, and 90,000 pounds breaking strength. In the hard steel, the elastic limit is about one-half the breaking strength; in the soft steel, it is only about one-third. The same proportion is not reached in steel castings, as in steel forgings. That means only, that in the present state of the art, we must use a little more material; which we certainly can do, because we get it more cheaply. The carbon in the hard steel has an average of about one per cent. Silicon is about one-half per cent; manganese is about one per cent. In very soft steel, the carbon runs down to about $\frac{2}{10}$ per cent. The silicon of steel is from $\frac{1}{10}$ to a quarter of one per cent., which accounts for the low elastic limit got out of the high breaking strain; and the manganese is under one per cent. So much has been done towards reducing the silicon, that I have no doubt that more can be done. Now, the product of any number of open-hearth furnaces can be very readily run into moulds of any size and shape. They must not be too complex, so that the casting will pull apart; or, if they are complex, the casting must be yielding. These castings of any size may be very cheaply made. They only have to be annealed; or, for certain purposes, they have to be hardened in oil. They are then turned up. Thus all the risks of cracks and physical defects in forgings may be avoided.

MR. HENNING.—The question I asked about steel came up to me in the way of inspecting the steel for the East River Bridge, because very eminent engineers in this country have put their opinions against the use of steel castings, and they have advised the engineers of that bridge not to use any, for fear of having flaws in the material; and I believe such opinions as I have heard expressed just now, will certainly lead to the adoption of cast steel in some detail. If I can get some more opinions from eminent engineers on that subject, I am sure it will influence something in that respect. In inspecting the steel, I have found that in the Bessemer steel used in that bridge, the elastic limit is from 42,000 to 47,000, neither above nor below; that the ultimate strength is generally 73,000, none below 72,000, and very little above 90,000, those being very hard specimens, being made so hard by water dropping on the material when rolled. But if the material in the casting has an elastic limit of 30,000, it certainly appears that it would be suitable for almost any use in structural purposes. The part I speak of is a detail which is really more machinery than anything else, and it would be difficult to make it any other way, except by casting. I would be very glad to know from any of the gentlemen whether they have had any experience in this matter of steel castings, unless it is out of place at the present moment.

MR. EMERY.—I would ask in that connection what the elongation is of the steel you are using in the bridge?

MR. HENNING.—Not below 15 per cent., nor above 25 per cent. generally.

MR. EMERY.—An elastic limit of 40,000?

MR. HENNING.—About 45,000; the elastic limit is more nearly 43,000, I would say, than anything else, with an elongation generally of 19 per cent. In plates I should say it is considerably lower; but in channels, and in angles, and in rods, we obtained over 15 per cent. elongation. In flat bars we have obtained very nearly 25 per cent., and in all this work now about 1,500 tons have gone through the shops; we have found but a few single pieces which were hard or brittle, so that they could not be used; but in almost every case, the simple application of a punch proved that that material was unfit for use. It either broke the punch or it broke the material; and the surface of the material when sheared or punched, showed the crack pretty closely. The material runs very uniformly, and it seems as though the idea of hard steel being introduced in any structure is exaggerated by almost all who have not used it. The steel is more uniform than any wrought iron that has been used in very large bridges. The tests show that, in the first place, before rolling; then, after rolling; and lastly, when it goes through the shops. But the working of the steel has a great effect upon it. Of course, no drifting must be allowed in any case, and, as far as the inspectors can see to it, it is prevented; and, I am proud to say, quite successfully. But the working of the steel in the hydraulic presses, or under heat, has given considerable trouble without annealing; and, when the steel is annealed, it goes back to its original condition, very nearly; but all other work on the material has proved it superior to anything else. It works better than any kind of iron, almost. But the heating of the steel, without annealing, seems to have a deteriorating effect, which has not yet been quite overcome; although we hope that before any amount of work of that kind has been done on it, experiments will be made, sufficient in number and character to find a method by which that steel will be worked without any injurious effect, whatever, to it.

MR. EMERY.—You mean local heating, instead of heating the whole piece?

MR. HENNING.—Local heating, I mean.

MR. OBERLIN SMITH.—I have used several hundred castings, weighing from 100 to 500 pounds, chiefly for crank and cam shafts, in a place where there is a violent jarring, and in some cases a good deal of wear. I have never broken but one shaft out of several hundred, and then it was after being used two or three years and subjected to a grea

deal of jarring. I have not tested any for strength and elasticity, but I have found them in practical use about the same as wrought iron, as near as we could judge; not as good as forged steel, but fully as good as wrought iron. I have found it peculiarly good for rollers running against cams, where the pressure was on the line of contact, and found them good in journal bearings. They seem to have less tendency to cut than wrought iron. In hardening, they are not very reliable, they are apt to have hidden cracks; but using them soft, I should recommend them for compressive strains. Perhaps, where human life and safety depended upon them, it would not be well to use them for tensile strains without further experiment.

MR. A. DAVIS—Before closing the question of this steam engine—as it is very essential that we should know something about the super-heating of steam in its different details—I should like to ask what was about the distance of the boilers from the cylinders of this engine; and if extra means had been used, or extra implements for lubricating the engine, while using these superheaters?

MR. LEAVITT.—The main boilers are 75 feet from the engine. The design is to put a small boiler close to the engine to be used for re-heating, and very extra pains have been taken for lubricating the engine throughout. I suppose there has been as much thought bestowed upon that matter as anything else, in connection with the design, and perhaps more, so as to have the lubrication of all the parts of cylinders, valves, &c., thorough.

MR. A. DAVIS.—I would like to ask what were the conditions of the lubrications, as we know that super-heated steam has been the cause of great distress? With regard to superheated steam in the cylinders, I would like to know whether there was anything specially used beyond ordinary lubrication of the cylinders, that we might learn something of some value for our future guidance?

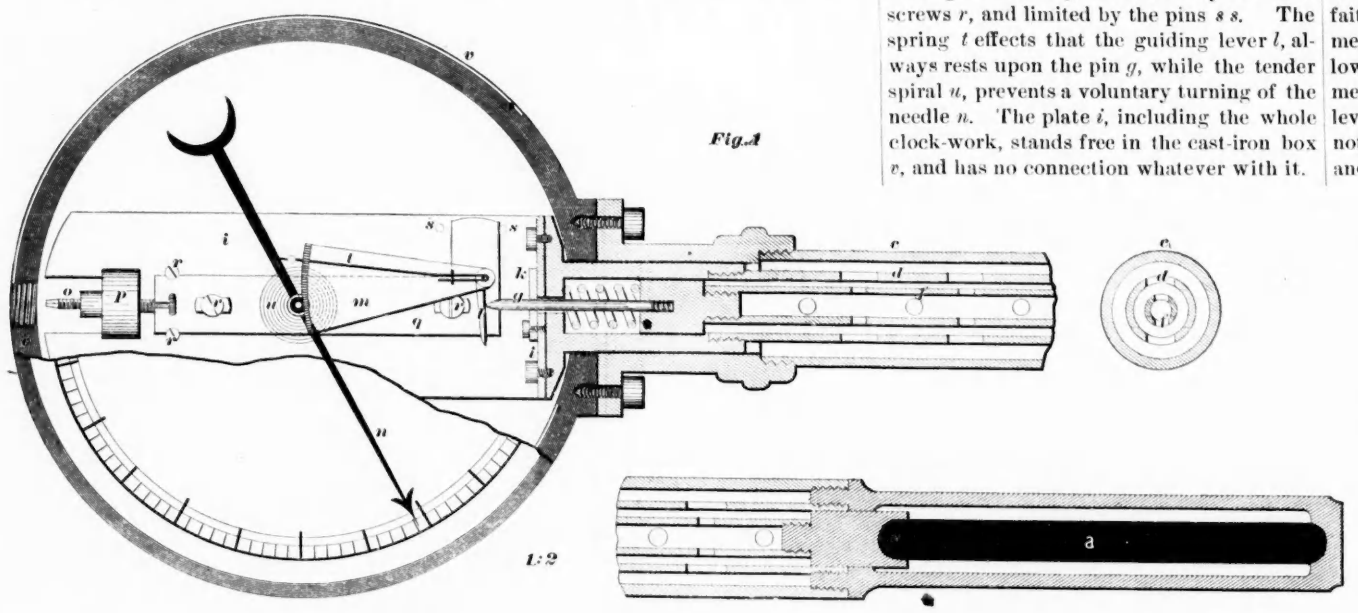
MR. LEAVITT.—It is not expected that the steam which enters the cylinders will be highly super-heated. It will be the ordinary boiler steam admitted there; but the superheated steam will be passed through the tubes of the re-heaters, drying up the moisture. The main function of the re-heaters is to dry up the moisture that is formed in the mass of the steam by the conversion of heat into work in the high-pressure cylinder. We have found valvoline oils to answer very well for high pressure. I have never had any direct experience with highly superheated steam in cylinders.

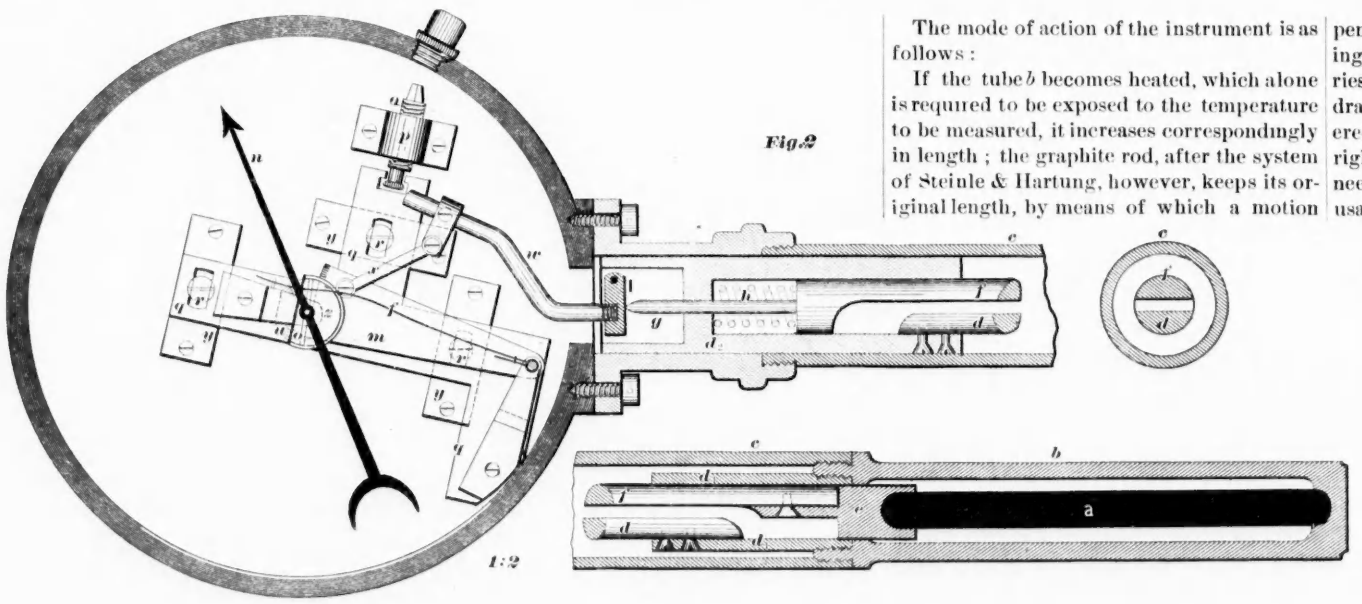
MR. EMERY.—I would suggest that the point the gentleman raised is met by the fact that the temperature in the low-pressure cylinder can never equal that in the high.

Investigations Concerning the Graphite Pyrometer.

(*Translated for the* AMERICAN MACHINIST *from the "Zeitschrift des Vereines Deutscher Ingenieure."*)

EVERY one who has been repeatedly under the necessity to determine high temperatures, in order to control the efficiency of the different technical apparatus which are applied for the production and transmission of heat, will have found what high advantages an instrument is capable of offering which notifies at any time the developed and transmitted degrees of heat, without requiring anything else than the reading off on the scale;—in fact, an instrument which works continually, and which can also at all times be exposed to the temperature requiring to be measured.





The latest instrument constructed for this purpose is the graphite pyrometer of the firm of Steinle & Hartung, of Quedlinburg, Germany, and of which we give an illustration. According to the assertion of the inventors, this instrument answers the required purpose admirably, is of great durability, and very convenient in the reading off, which can be done with the greatest exactness, even at a considerable distance.

Fig. 1 of our illustration shows the instrument in its original form, while Fig. 2 shows its latest transformation with improvements.

The graphite rod (gas retort coal) *a*, Fig. 1, stands in the tube *b*, which has been drilled out of a solid piece of bar iron, and these two parts form essentially the foundation for the whole instrument, in as far as the difference of their expansion influences the measurement. The hollow iron tube *b* is fastened by an exterior joint to the safety-tube *c*, while its interior joint brings about the connection with the tube *d*, which carries on its other end the plate *i*, upon which the whole wheel work is erected. On the connecting point in *d*, as well as in *b*, is carried the head or screw which embraces the graphite rod *a*, above, and through the tube *f*, as well as the pin *g*, the connection with the dial is accomplished; the strong spiral spring *h* maintains the contact between *a* and *b*. On the lower part of the plate *i*, which is bent round rectangular (as shown in the figure), the small plate *k* is screwed, which prevents the pin *g* from shifting to either side. *g* touches the guiding lever *l*, which rests with the toothed arch *m* upon a pivot, and consequently transmits every dislocation or motion from *g* upon the needle *n*, by means of a spring.

The screw *o*, whose nut is cut in the bronze piece *p* (which is let in in *i*), permits of a raising or sinking of the angular plate *q*, which carries a toothed arch with touch-lever as well as spring and pointer. The exact guidance of *q*, is secured by the four screws *r*, and limited by the pins *s s*. The spring *t* effects that the guiding lever *l*, always rests upon the pin *g*, while the tender spiral *u*, prevents a voluntary turning of the needle *n*. The plate *i*, including the whole clock-work, stands free in the cast-iron box *v*, and has no connection whatever with it.

The mode of action of the instrument is as follows:

If the tube *b* becomes heated, which alone is required to be exposed to the temperature to be measured, it increases correspondingly in length; the graphite rod, after the system of Steinle & Hartung, however, keeps its original length, by means of which a motion upwards of the needle *n* is occasioned. Through the contraction of *b*, on cooling, the needle is carried in the direction of zero.

The tubes *d* and *f*, are multifariously punched, in order to allow the air between and in them to take a uniform temperature, and prevent thereby an unequal expansion of the first, which would show itself as a mistake in the pointing out of the temperature. It was, however, very soon found that the influence of the radiating warmth of the protecting tube was by far larger than that conveyed through the stratum of air; that, therefore, the tube *f*, protected by *d* from the radiation of heat, remained shorter than the last, which naturally occasioned that the indication of temperature pointed considerably higher than it should be.

To avoid these mistakes, the tubes were replaced by rods of a half-rounded shape (see Fig. 2), from which by means of the tube-barrel *d* they are again properly and carefully connected. The arrangement of the clock-work remained first of all exactly the same as in Fig. 1. And if through this improvement the fault above-named is, in a certain measure, obviated, it will still happen again, if one were obliged in the using of the instrument to expose to the temperature requiring measuring a piece longer than the proper measuring tube, as for instance, in sheet-iron funnels, and thereby not carefully observe the position of the instrument in opposition to the current of the heated gas. Differences of 10° to 15° showed themselves, if the instrument was led into the chimney in a manner that the plane of the scale lay parallel with the direction of the current of the gases, an effect of the protection which one rod afforded to the other from the radiating heat. It is in such cases, therefore, necessary to adjust the pyrometer with the scale-plane perpendicular to the direction of motion of the heated gases.

In reality, the observations of others deviated extraordinarily from the experimental results of the experimenter. On account of this the manufacturers received many reclamations, which induced them—as they faithfully sought the imperfections in the mechanism of transmission, as is shown below—to make the alteration and arrangement as shown in Fig. 2. Here the guiding-lever itself rests in the tube-barrel d_2, and not on the toothed arch. The arms *w* and *x* operate the lever on the arch in the vicinity of the toothed rim, which prevents any small deviation from being enlarged in such a proportion as by the old arrangement. The whole wheel-work is there also independent of the rod *d*, fastened in the cast-iron box *v*, upon three small plates *y*. The needle is also not more firmly connected with its axis, but made movable upon the same, in order to heighten substantially the appropriation of the apparatus for correction, so peculiar and practical is the graphite pyrometer.

This arrangement serves, in case the needle has, after cooling, not gone back to the number corresponding with the air temperature, to put it back; this happens in general after every considerable heating of the pyrometer. The plate *q*, which carries the toothed arc and needle, is, through the drawing tight of the screw *o*, somewhat lowered (Fig. 1), respectively drawn towards the right (Fig. 2), and in this manner is the needle moved towards zero. By a constant usage of the pyrometer this arrangement would soon refuse its service, as the displacement of *q* by the pins *s s*, respectively, by the indentations of the screws *r*, is limited. It appeared, therefore, judicious to undertake beforehand only the correction of the needle *n*, by the distortion upon its axis, certainly so long until the toothed arc has, through the repeated and remaining extention of *b*, entirely run off. This would be the case after the instrument had been continually used for two or three months, and necessitated a previous putting back of the arc by the screw *v*, for its whole length, after which the regulation, by means of the needle, could only commence again. Through another construction not here represented, the manufacturers executed the wish of the experimenter. Upon the axis of movement and pointer is fastened a bronze disc, over which lies the needle which is held fast by a small plate and splint, against which it is pressed by a spring. Every displacement or removing of the needle, not intended in opposition to the axis, is by this means prevented.

It is stated that all of the twenty graduates who, this year, take their degree as civil and mining engineer at the Rensselaer Polytechnic Institute, Troy, have already secured lucrative positions, and that a number of other good situations were left over, waiting for the right men to fill them.

Railroad building thus far this year, is about up to what it was for the same period in 1880.

A Brief Treatise on the Steamboat Cam.

BY LEWIS JOHNSON.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Cams are very largely, if not exclusively, used in operating the steam and exhaust valves of the engines on our river steamers West and South. Although familiar to marine engineers in these localities, cams possess features not so well understood by many others of the profession. It is possible that this article may be of value to this class:

CLASSIFICATION.

Cams are of three different types—

1st. The full stroke cam.

2nd. The cut-off cam.

3d. The folding cam.

I propose in this paper to consider only types 1 and 2.

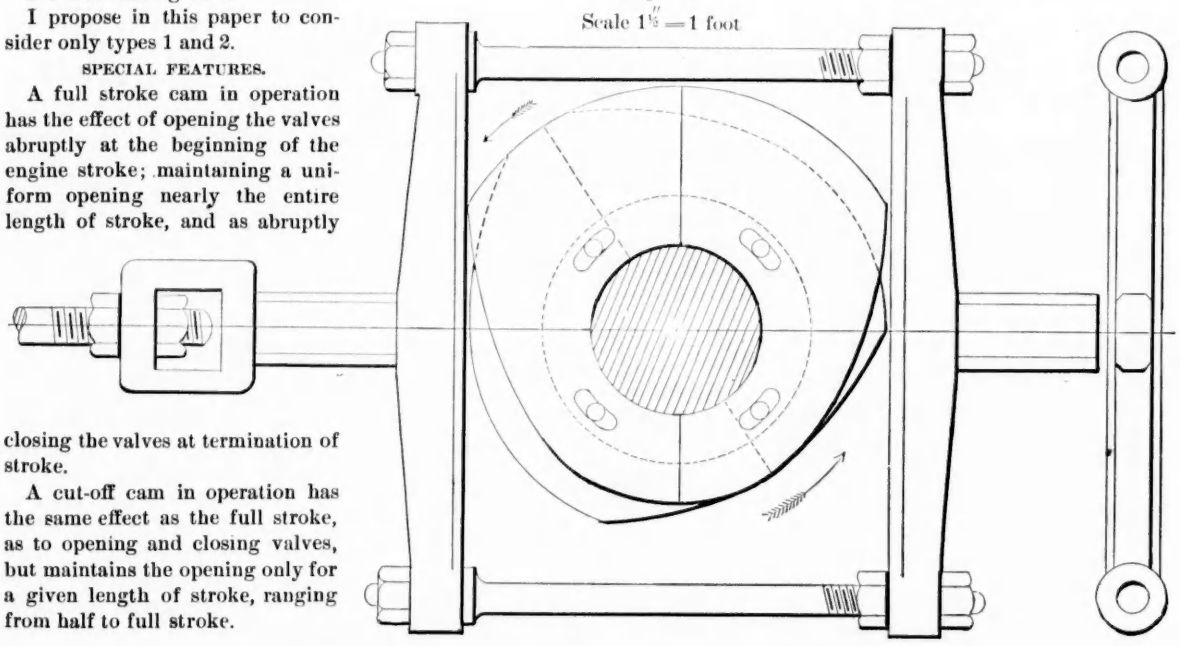
SPECIAL FEATURES.

A full stroke cam in operation has the effect of opening the valves abruptly at the beginning of the engine stroke; maintaining a uniform opening nearly the entire length of stroke, and as abruptly closing the valves at termination of stroke.

A cut-off cam in operation has the same effect as the full stroke, as to opening and closing valves, but maintains the opening only for a given length of stroke, ranging from half to full stroke.

Fig. 1.

Scale $1\frac{1}{2}$" = 1 foot



Within reasonable limits both full stroke and cut-off cams are capable of giving any amount of travel to valves, and while the dimensions differ according to travel, etc., the same rules are applicable for laying off cams of all dimensions.

Any enlargement in the dimensions of cams involves a corresponding enlargement of the yokes embracing the cams, but the same yoke will embrace cut-off cams that differ only in the limit of their cut-off.

Cams are always made of cast iron, and sectional or in halves, for convenience of renewal when worn out or in case of breakage. They are sometimes, but not always, bored to suit the crank shaft, occasionally being cast of approximately proper size in this respect.

The working faces of cams are never finished by other than cleaning off lumps and sand, by rough filing or with the grindstone.

GEOMETRICAL CONFORMATION OF CAMS.

By reference to Fig. 1, the lines embracing a full stroke cam may be seen. It will be observed that Fig. 2 is enclosed by four curved lines, *P*, *P*, *K* 1 and *K* 2. The position of center of crank shaft in this irregularly curved body is at *X*. The curved lines *K* 1 and *K* 2 differ in radius, but are drawn from the same point *X*, and hence are concentric with the crank shaft.

The curved lines *P*, *P*, are of like radius, but are drawn from the opposite points *S*, *S*, shown at the intersection of the curved lines *P*, *P*, with the curved line *K* 1. These lines *P*, *P*, are eccentric to the crank shaft.

Figs. 9, 11, 14 and 16, show the lines embracing cut-off cams of given limit, varying from one-half to seven-eighths stroke, viz., one-half, five-eighths, three-quarters and seven-eighths. It will be observed that the lines are more numerous than those embracing a full stroke cam, eight being required to enclose a cut-off cam, except the half stroke; as in the figure of a full stroke cam, *X* represents center of crank shaft. In Figs. 9, 11, 14 and 16, like letters represent like lines, and lines designated by like letters have the same radius. Let us take Fig. 11 for illustration. Four curved lines are concentric with the shaft, being drawn from the center *X*, and the remaining four are eccentric to the shaft. The lines concentric to the shaft are K 1, K 2, of differing radius, and the lines E 1, E 2, of like radius.

The lines eccentric to the shaft are *H*, *H*, *P*, *P*, all drawn with the same radius, but from different points.

APPLICATION OF THE LINES TO LAYING OFF CAMS.

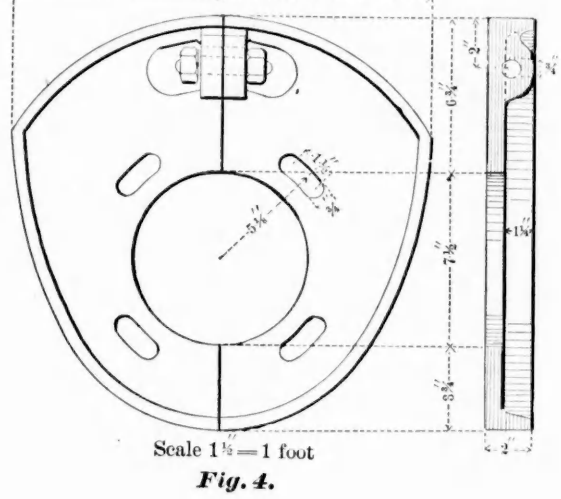
As before stated, Fig. 2, represents the lines embracing a full stroke cam of given dimensions, which are assumed to be as follows, viz.:

Diameter of crank shaft, $7\frac{1}{2}$ inches; travel of cam, 3 inches; width of yoke, 18 inches.

With one point of the dividers at *X* (center of crank shaft), draw the circle *E* equal to width of yoke, 18 inches. Through this center *X* draw the two right lines *A* and *B*. On the line *B*, at the intersections of the curved line *E*, draw the two vertical lines *A* 1, *A* 1. With a radius of $10\frac{1}{2}$ inches, and one point of the dividers at *X*, draw the curved line *K* 1. With a radius of $7\frac{1}{2}$ inches, and one point of the dividers at *X*, draw the curved line *K* 2. With a radius of 18 inches, and one point of the dividers at the intersection of the curved line *E*, with the vertical line *A* 1 at *S*, draw the curved line *P* opposite to *S*, and let it merge or lose itself in the curved line *K* 2. Draw the other curved line *P* from the other point *S*, and we have a full stroke cam of the dimensions required, which is shown complete at Fig. 3.

In Fig. 4, is presented an enlarged view (here reduced) of a full stroke cam, as usually constructed.

The engravings including Fig 8 and



Scale $1\frac{1}{2}$" = 1 foot

Fig. 4.

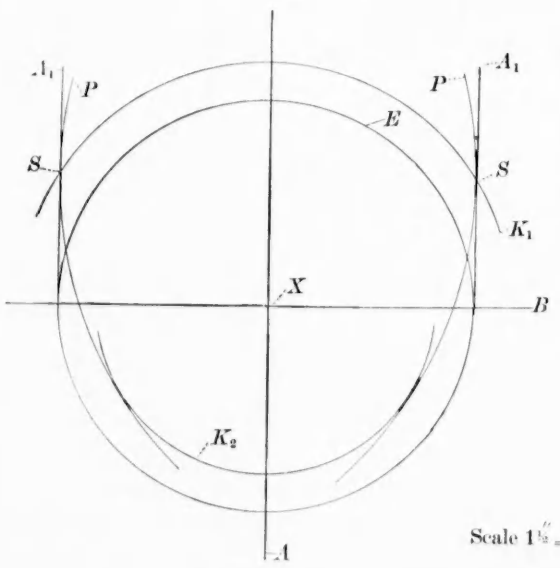
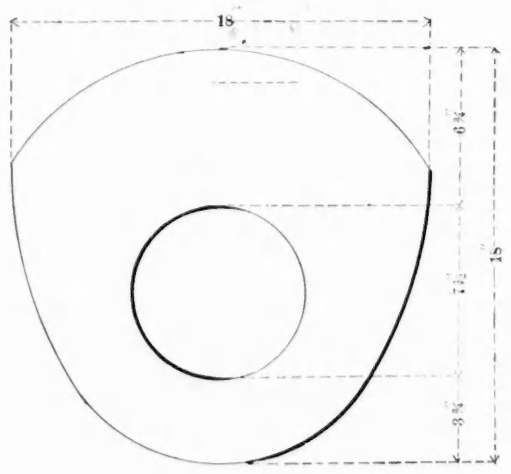


Fig. 2.



Scale $1\frac{1}{2}$" = 1 foot

Fig. 3.

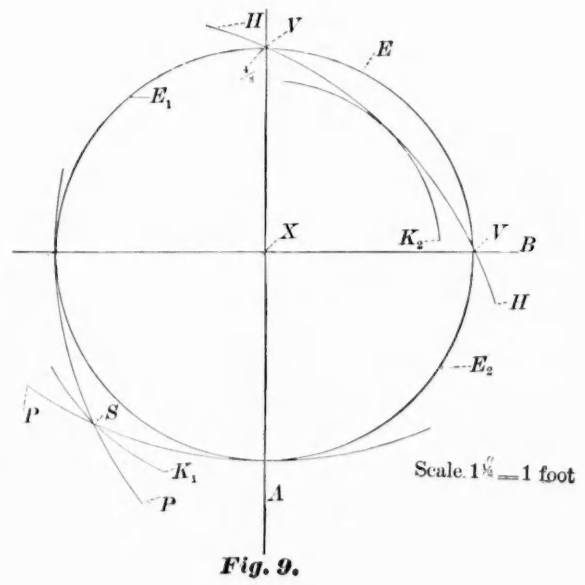


Fig. 9.

From the center *X* draw the series of diagonal lines through the points of intersection of the vertical lines 1, 2, 3, 4, etc., from the circle *E* 1, and terminating at *X*. We will now proceed to utilize the scale afforded by Fig. 1, in laying off the cut-off cam shown at Figs. 2, 3, of half stroke limit.

With *X* as a center, draw the circle *E*, having a diameter of 18 inches. Bisect this circle with the straight lines *A* and *B*, bearing the same relation to their enclosing circle that the lines *A*, *B*, do to the circle *E* in Fig. 1.

It will be observed in Fig. 8 that the vertical line *A* is also No. 4, representing $\frac{4}{8}$, or half of the stroke. With a radius of 18 inches, and one point of the dividers placed at *V*, the intersection of the circle *E* with the horizontal line *B* in Fig. 9, draw the opposite curved line *P*. With the same radius, and one point of the dividers at *V*, the intersection of the circle *E* with the vertical line *A*, draw the opposite curved line *P*, the two lines *P* intersecting at point *S*. With the same radius, and one point of the dividers at *S*, draw the opposite curved line *H*, *H*. The lines *K* 1 and *K* 2 are drawn respectively with the radiuses $10\frac{1}{2}$ inches and $7\frac{1}{2}$ inches, and only serve in a half-stroke cam to intersect the curved lines already drawn, as shown in Fig. 9. In practice, the sharp point shown at *S* would be objectionable, owing to rapid wear at this point, and hence a modification of the dimensions given for this half-stroke cam would be required to obtain a larger wearing surface at the point *S*, but the cam of this limit is correctly drawn in Fig. 9.

* NOTE.—The remainder of this paper with engravings will appear in our next issue.

"Wood paper" is the name of a new idea. In this the paper is given a thin veneer of the wood desired, and can be rolled up like the ordinary paper. This paper, properly applied, gives the walls of a room all the appearance of being worked in hard wood. By means of machinery, the manufacture of wall paper is materially hastened. An ordinary machine will print from 2,500 to 3,000 rolls per day of eight-colored paper, while fifty rolls is a good day's work by hand. The latter process, however, is used on the very finest paper.—*Paper World.*

LETTERS FROM PRACTICAL MEN.

Experiments with Super-heated Steam.

Editor American Machinist:

The two following described experiments in the evaporation of water, by the use of super-heated steam, may be of interest to some of your readers.

Omitting minor details, I would say that I used a jacketed pan which was open at the top and flat on the bottom, having a heating surface of 94⅝ square feet, under the bottom. Steam was admitted inside the jacket through four 4″ pipes, and exhausted by similar pipes.

The super-heater was built close up to the inlet end of the pan, and its waste heat was passed in a serpentine course under the pan, first striking it about four feet from the end, thus imparting additional heat through the jacket to the steam within.

My first experiment was with the exhaust steam from two engines, using what would be equivalent to the exhaust from one plain slide-valve engine, taking steam at 70 lbs. pressure and giving out about 125 H.P.

Water in pan was 3″ deep.

Pyrometer in steam, as it left the super-heater, showed 675° to 700° Fahrenheit.

Thermometer in pipe at foot of pan showed heat of the departing steam to be 374°.

Gases in smoke stack, three feet from pan, showed over 600°.

Steam gauge at super-heater showed no pressure at that point.

The water did not commence to boil until the pyrometer had passed 685°, and at 700° it showed but little agitation, and this was directly over the four inlet pipes, with hardly any ebullition elsewhere, though the heat was kept up five or six hours.

My second experiment was with live steam direct from the boilers, kept up to pressure by means of a valve at the exhaust end of the pan, which was held sufficiently open to permit but little more than the water of condensation to pass through—no trap being used at this time.

Water in pan was 12″ deep.

Pyrometer averaged 533°.

Thermometer at exhaust end 303°.

Gases in smokestack 442°.

Temperature of feed water 72°.

Steam gauge at super heater 66 lbs.

Water evaporated per hour 282 gals., being $\frac{297}{100}$ gals. per foot of heating surface, or $4\frac{7}{10}$ gals. per minute.

No note was taken of the quantity of water condensed within the jacket, or of the fuel consumed under the super-heater.

I was somewhat surprised at the poor results gained from the use of exhaust steam, and while I have a theory in regard to its cause, I should be pleased to learn the views of others about it; and also the results reached by such as have used exhaust or live super-heated steam under open pans, for the evaporation of various kinds of liquids. ALBERT STEARNS.

Brooklyn, N. Y.

Notes on Mechanical Drawing.

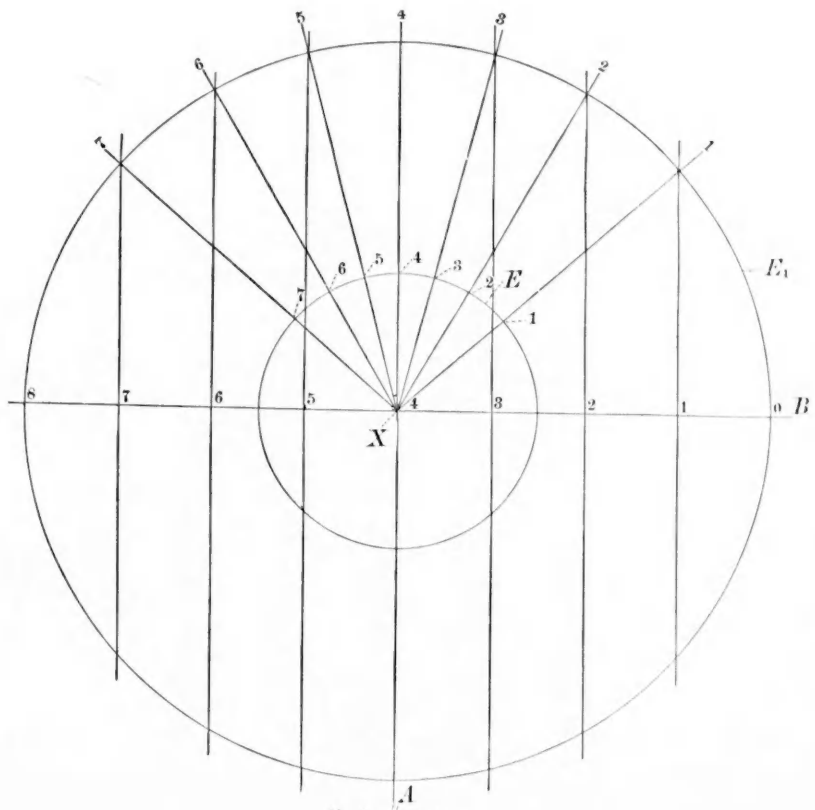
Editor American Machinist:

Mr. S. W. Powel, in his communication published in your issue of June 11th, having evidently received a wrong impression of my meaning from my letter published May 7th, I will endeavor to make it clearer.

A working drawing is made on the best paper that can be found to stand constant handling, and numerous erasures and sand-paperings. This drawing is inked in and finished up complete with dimensions, notes, and all necessary information on it. It should then be backed and bound with muslin. It is kept in a drawer, and never rolled. It is the original drawing for office use and reference, and is subjected to much handling. A cloth tracing is made from this drawing, for the purpose of getting bright and clear blue prints for use in the shop; and this cloth tracing is far better preserved if rolled on a stick than if kept flat in a drawer; in fact, it will indefinitely retain its smoothness and freshness if kept in this way. The sticks are kept in pigeon-holes, numbered and indexed like the drawers, but are comparatively seldom referred to; while the drawings in the drawers get such handling as would use up cloth tracings in a very short time, if kept in the same manner and for the same purpose.

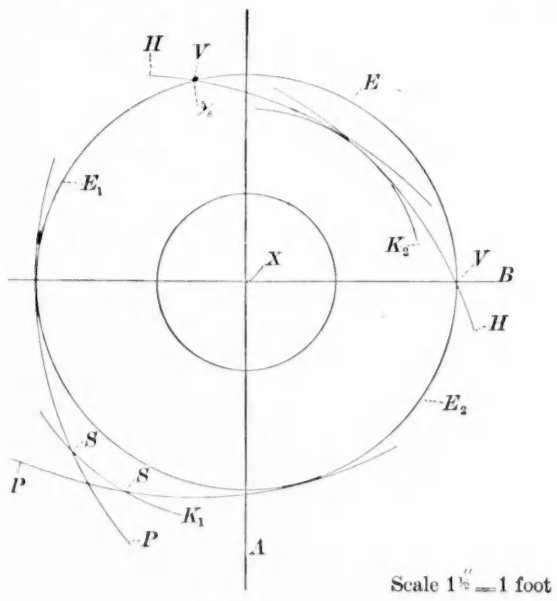
Thus far the cloth tracing's only use is for making blue prints, and this system differs from Mr. Powel's in making original drawings on a material capable of standing any amount of erasures and bad usage, and, in addition, making a cloth tracing, while he makes the original drawing on a material selected for its thinness, transparancy and tint, so as to blue-print direct from the drawing, and thus save making the tracing. With great respect for Mr. Powel's judgment and knowledge of the subject, I must differ with him here. He sacrifices the utility and durability of the drawing to save a tracing, which is made by an apprentice, supplying him with the best possible practice and manual training, and which will make a far better blue print in one-twentieth the time that the drawing will. Not only this, but he also loses the most valuable use of the tracing, which is to be a record of the drawing as originally made. With this tracing in existence, the drawing can be scratched and altered ad libitum, and a new cloth tracing made and *rolled* on the same stick with the first, thus making the second edition of the work, revised and re-written on such a date. The cost of these records is nothing compared with their value in a progressive shop, as Mr. Powel, on reflection, will doubless admit. WM. H. THORNE.

2200 Wallace St., Philadelphia, Pa.



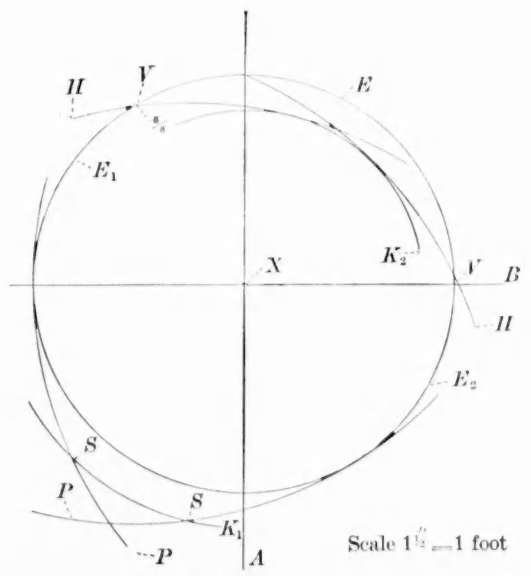
Scale 1=1 foot

Fig. 8.



Scale 1½″=1 foot

Fig. 11.



Scale 1½″=1 foot

Fig. 14.

Cushion and Counterbalance.

Editor American Machinist:

I did not expect to say more on this subject, but seeing that there are those who entirely ignore the utility of cushion in balancing an engine, I cannot refrain from saying a few words more on the subject. The fact that "cushion relieves the crank pin of a sudden strain, and helps to prevent pounding," furnishes evidence of its efficiency in helping to balance the reciprocating parts.

We are aware that the stored energy of these parts must be dissipated throughout the engine, but the manner in which it is done has much to do with the effect on that body.

The effect of cushion, I take to be the reciprocating parts; what the hair spring is to the escapement in the watch, or the attraction of gravity to the pendulum.

A wagon with springs rides more easily than one without; the weight in the seat responding less to the vibrations underneath.

While these are not altogether analogous, yet they serve better than the illustration used by one of your correspondents, viz., "The man with the meal sack on his back." We might even use this to establish our theory, by saying that the horse would find some relief in trotting if the man carried the sack, provided he proved to be a sort of *cushion* between the horse and meal.

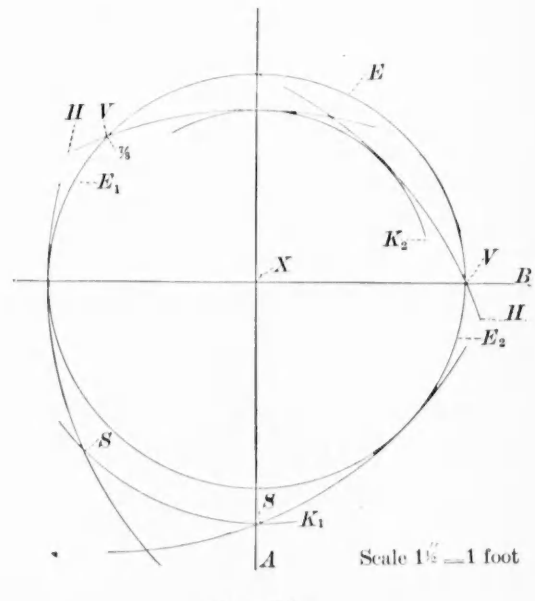
But to use a better example, take an engine itself, suspended in air, as one has suggested, and strike it at either end, or at both ends alternately, if you please. But in one case strike on some solid part, and in the other upon a quite elastic spring. Query: Which will cause the greater vibration, the blows in either case being equal?

Chattanooga, Tenn. QUIRK.

Points in Green Sand Moulding.

Editor American Machinist:

There are three kinds of iron and brass moulding, generally considered as green sand, dry sand, and loam. They correspond with the three graces, faith, hope, and charity. Green sand represents the first of the graces more than dry or loam moulding, for the green sand moulder has to have a great deal of faith, and a fair amount of hope. The foreman and the proprietor must possess the last of the graces—charity. The dry sand moulder has a surer process, and is more certain of success with his mould than the green sand moulder. His flasks being of iron, and his mould dried, he needs much less to call upon his stock of faith and hope. The loam moulder really has solid work, from the fact that his layer of loam is thin, and the outside usually of brick. If his plates are sufficiently perforated (they cannot be too much so), as long as the necessary strength remains, the moisture will be speedily expelled from his mould, and a surer result follow than by green sand moulding; while there is a much better opportunity to let off the vent. There has been a feeling of "caste" existing between dry sand and loam moulders on one hand, and green sand moulders on the other, the latter receiving less compensation for their services than the former. But the fact is that more judgment and greater skill is required to make good green sand work, than dry sand or loam work. One of the largest iron working establishments in this



Scale 1½″=1 foot

Fig. 16.

country, celebrated for the perfection of its work (I allude to the Corliss Steam Engine Co., of Providence, R. I.), takes its dry sand moulders from the green sand heap. I refer to this matter merely to direct the attention of those who employ moulders, and the fact that green sand moulders, who are competent to mould any piece that can be made in green sand, are mechanics of more than ordinary ability, and should receive as much pay as any other moulder. Being acquainted with all three branches, I know I speak understandingly.

There are two ways of making moulds to a mathematical certainty. One is to make them good, and the other not so good. There is one thing to observe in the construction of a mould that tends largely to make good work, and that is the joint. As a general thing, there is not sufficient thought given to making the joint, or preserving it after it is made. The firmer and smoother the joint, especially if steep, or rounding or irregular, the cleaner will be your lift when the cope is removed. Nothing looks so shabbily in a mould as to see the joint rammed below the top edge of pattern, so much as to have pieces along the edge of the pattern that belonged to the cope. Oft-times it happens that copes drop out in closing, and from no other cause than the joint being too soft. It was rammed down, and there was more to pick up than belonged to the cope. In the moulding of any piece, where the joint should be in the center of a round or an oval form; if the joint is not firm enough, it will ram below the center, and the sand of the cope will be hooked under, and bad joints be the result. I never saw a moulder who made good, hard joints to his drags or nowels.

Toledo, Ohio. FOUNDRYMAN.

Keys for Pulleys—A Letter for Apprentices.

Editor American Machinist:

A key is a mechanical device, and being generally of a wedge shape, is used for the purpose of forming a connection between two metallic surfaces in such a manner as to transmit equal force to each one; hence the two surfaces are practically as rigid as if they were a solid body.

To analyze the strains which a key has to resist, we must first determine how great is the strain; and second the kind of strain. The conditions of the former question are dependent entirely upon the radius of the pulley, also the width and tension of the belt; while in regard to the latter we know the key to be subjected to a shearing strain, which exists only so long as it is held firmly by the sides of the key ways in the shaft and the hub of the pulley. A key, in order to best resist the strain to which it is subjected, must be properly fitted to a key way of a sufficient width and depth. The sides must be exactly parallel, and the grooves cut in the shaft and hub of the pulley, to form the key way, must be exactly parallel and in line with each other. A key should be neatly fitted on all sides, particularly top and bottom, because it is very difficult, if not impossible, to fit a key to drive tight sideways. If a key is fitted all over and the key way be not of a uniform taper, the key will have a bearing at one end only, and, in consequence, when the key is driven, will tip the hub of the pulley to one side, as shown in Fig. 3 of the accompanying engraving, which will cause the pulley, if bored true, to wabble. To remedy this difficulty round out with a file the upper part of the groove in the hub of pulley, as shown in Fig. 1, at the ends, which will allow the key to bear in the middle of the hub, thus drawing it squarely against the shaft.

This plan works well when the hub of the pulley has been bored parallel and made to fit the shaft properly, but if the hole is tapering or too large, when the key is driven the pulley will be drawn to one side, throwing it out of balance, so that when running at a high speed it will cause the shaft to spring.

If there is anything that appears unpleasant to the eye of a skilled mechanic, it is to see a pulley improperly hung. The hub of a pulley should always fit the shaft closely. To make it do so is an operation that few mechanics have learned. By some the hole through the hub of a pulley is cored considerably larger than the shaft, and in the shape of a polygon. The shaft also is made the same shape as the hole in the hub of the pulley, and a number of keys, corresponding in number to the sides of the polygon, are driven upon all sides in such a manner that when they are all tight the rim of the pulley will run true. In some cases the rim of the pulley is not turned, and the reader will comprehend that for this and other reasons, the operation described requires a skilled mechanic and consumes considerable time.

Where a shaft is heavy it is a good plan to slightly recess the hub of a pulley, leaving a bearing at each end only; but if the shaft is very light, this course would result in springing or bending the shaft when the key was driven.

To give the dimensions of a key by rule will be of little value unless accompanied by a practical illustration and a demonstration of the duties of a key under certain circumstances. We will take the following for example, considering the shearing strength of a square inch of wrought iron to be for a rectangular bar ½″ by 2″ edgewise, twenty tons; while for the same sized bar flatwise, ten tons, which results are taken from the best authority. Example: A pulley of 48″ diameter, hung upon a 4″ shaft, is required to transmit forty horse power at a speed of 125 revolutions per minute. What strain at the periphery of the pulley is acting as a lever upon the key?

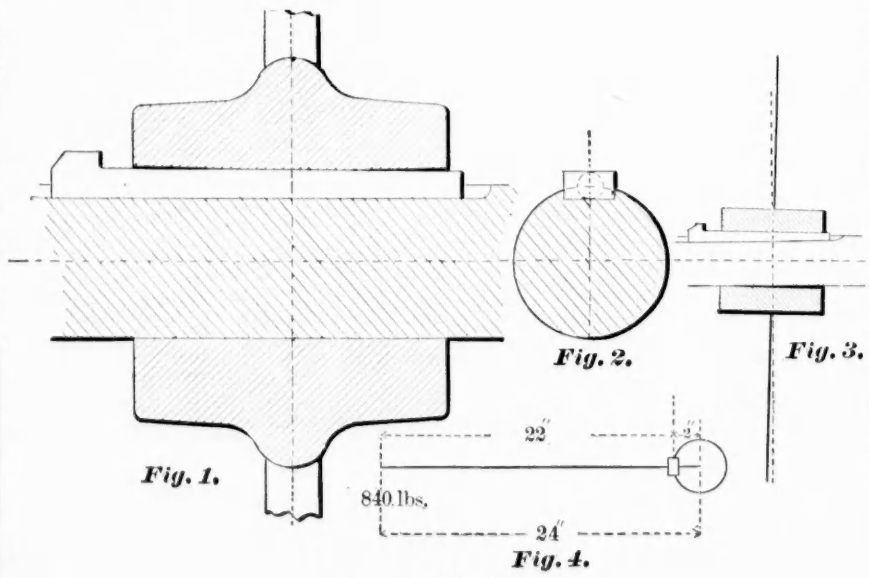
4 × 3.14 = 12.56 feet in circumference, and 12.56 × 125 = 1570 feet per minute. 33,000 × 40 = 1,320,000 foot pounds, and 1,570 ÷ 1,320,000 = 840 foot pounds as a steady strain on the belt, which must adhere to the pulley face without slipping, to transmit the power required in the stated time.

So if the 840 pounds strain is applied to the face of the pulley, it will act upon the same like a lever, illustrated in Fig. 4. 22 ÷ 2 = 11, and 840 × 11 = 9,240 pounds acting constantly as a shearing strain upon the keys. This we will suppose to be steadily applied, and as this is equal to five tons, according to our figures it would shear off ¼ of a square inch rectangular, or a key ¼″ × 1″. But, taking into consideration the friction of the hub on the shaft, the strain referred to would be less. These considerations may be left out, and we may make the key ½″ × 1″ in order to insure greater stability and firmness as well as to provide for sudden strains to which the shaft is likely to be subjected. For small shafting a good proportion for keys is as follows: Take one-third of the diameter of shaft for width of key, and one-half of this for the thickness. To lay out the key way properly, take a pair of dividers set to a radius of half the thickness of key; place one point upon the line representing the circumference of the shaft, and strike a circle, as shown in Fig. 2. The thickness of the key will thus be properly divided between the shaft and the hub.

If a key is made with too much taper, it will work loose; therefore it should have only sufficient taper to allow of easy fitting and driving. This proportion necessarily depends upon the length of the key, short ones generally having, in proportion, more taper than long ones.

HERMAN T. C. KRAUS.

Brooklyn, New York.



KEYS FOR PULLEYS.

Figured Dimension Drawings.

Editor American Machinist:

I herewith enclose some drawings with my plan of marking dimensions. They are shaded on one side to give them prominence on the board. The figures (which may be in red ink) are placed at one side, so as not to be mixed with the drawings, in all cases, excepting where it would be absolutely inconvenient to do so.

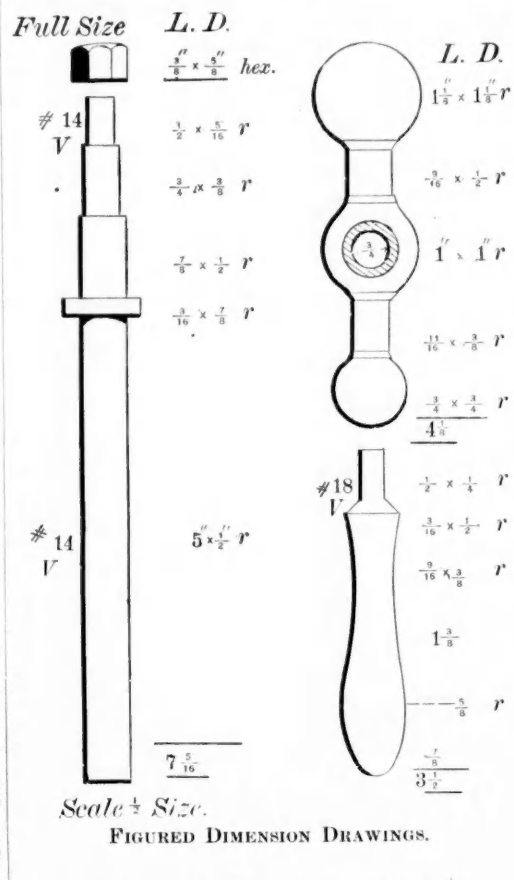
The few words and letters necessary for explanation may be placed at one corner of the board in the same manner that they are on maps, and when once learned would not be forgotten.

The drawings on some boards are very much mixed up with lines and figures, so that it is very confusing to get the dimensions. The head of the workman has to be turned this way and that way to see the figures, while some designations are put in places too small for the figures and dimension lines.

Much valuable time is spent in this perplexing manner, and it is a large item of expense in shops where there are many workmen, as I well know.

The drawings being placed vertically on the board are easily seen, and the figures are easily read. There may be extreme cases where the figures would have to be written at right angles to those shown. There might also be need of an end view in some cases.

PLAIN.



Scale ½ Size.

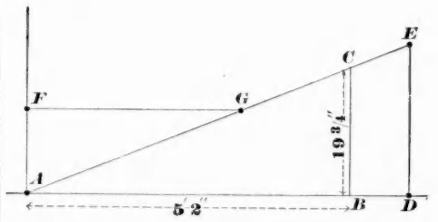
FIGURED DIMENSION DRAWINGS.

Pitch Circles.

Editor American Machinist:

A. W. Fox asks, in No. 23 of the AMERICAN MACHINIST, for information in regard to pitch circles of gears. For his benefit, I will say there is but one exact rule for finding the diameter of a pitch circle, viz.: Multiply the pitch by the number of teeth, and divide the product by 3.1416. Having found the circle, it may be carefully spaced off with a pair of dividers.

It is true, as Mr. Fox states, that the "divider steps," or the distance between two consecutive pitch points, measured on a straight line, is *less* on a small wheel than it is on a large one; but this is no discrepancy, as he thinks. It is the *circumferential pitch* which should be the same on both wheels, which it will be if laid out by the above rule. The "chordal pitch" will naturally be smaller on the small wheel than on the large one, but this has nothing to do with the smooth working of the gears, if the *tooth curves* are laid off correctly.



I may here give a graphical method of finding the diameter from the circumference and *vice versa*, for those who would prefer to use it, although graphical methods are never as reliable as those arrived at by arithmetical processes.

Referring to the above diagram, draw a fine line, as *A D*, upon a board, or piece of paper. Lay off, accurately, a distance, *A B*, of five feet and two inches. Then from the point B draw a line *B C*, at right angles to *A B*, and lay off the point *C*, 19¾ inches from *B*. Now draw an indefinite line through *A* and *C*. This will be a "circle angle" which may be preserved for use at any time.

To find the diameter of a circle when the circumference is given (the circumference is equal to the pitch multiplied by the number of teeth), measure off on the line *A D* from *A*, a distance equal to the circumference. The line drawn at right angles to *A D* from this point, and meeting *A E*, will be the diameter. Thus the diameter of a circle whose circumference is 5′ 2″ is 19¾″. A circle whose circumference is *A D* has a diameter equal to *D E*, etc.

If the diameter is given, we may find the circumference by laying off the diameter on the line *A F*, drawn at right angles to *A B*. For instance, *F G* is the circumference of a circle whose diameter is *A F*.

C. A. SMITH.

Bay City, Michigan.

The Mississippi Steamboat.

Editor American Machinist:

Having read the communications of "Easy Way," I am pleased to see this subject brought up for discussion. I hope some of the old-time engineers may be induced to publish what they know about steamboating, together with drawings of the machinery of these boats. I have had a little experience myself, but I don't feel competent to do the subject justice.

Some of the phrases and statements used by "Easy Way" sound to me a little unfamiliar; for instance, "a possible change of

a foot in the relative vertical location of the cylinder, slides and crankshaft," seems exaggerated.

In all the many years I have been acquainted with steamboats and steamboat men, before the Government Inspection laws were enacted in 1852, and since, I have never heard of 225 pounds of steam being carried for ordinary work, or otherwise.

I never heard of safety valves being loaded to 500 pounds. I have never seen Bourdon gauges as small as a dollar, or graduated in 25-pound notches, or indicating 300 pounds. I have seen 175 pounds indicated by the gauge before the inspection law, but never since. I fear "Easy Way" has made some mistake in his figures.

The boilers I have been familiar with were from 36 inches to 44 inches, seldom so small as 28 inches, and generally from 24 feet to thirty feet long. The engines are long stroke, but I have never seen any of 8 diameters, and only remember one instance of 6 diameters.

Many of the engines up to 1852 had single-beat "skillet valves," but since then the double-beat or balanced poppet valves are mostly used.

The slide valve probably made its appearance with the first steamboats on the Western rivers, and was discarded many years since. I only remember a few instances of this kind of engine, and these had poppet cut-offs, consisting of a single poppet valve, acting for both ends of the cylinder, the main valve being a slide, with little or no lap. "Easy Way" makes a mistake in denominating these steamers "pasteboard boats." A boat that will carry a pair of 30 or 36-inch cylinders, 12-feet stroke, with 140 pounds steam, and as much as 2,000 tons of freight, is necessarily not of a pasteboard nature, although not as rigid as an ocean steamer.

The throttle valves are not solid with the stem, but are loose disks; the poppet valves are also made in this way and riveted together. The throttle valve stem in the better class of engines has a swivel, to relieve it from turning in the stuffing box. I never saw any with a "quarter of a turn slack in the key-way"—that would be preposterous and unsafe; but they might have had a quarter of a turn slack in the threads when worn. Many of the throttle and poppet valves were relief valves; that is, they had a small valve on the back of the main valve, which opened first, relieving the pressure on the main valve. These valves were not quick enough in their operation, and were not much used.

There is evidently a mistake in "Easy Way's" figures as to "14 or 15 feet between the back cylinder head and the front end of the slides," but I can't conceive of a bend of two inches in that distance without breaking the boat in two.

The piston rod stuffing boxes are generally packed with hemp packing, as it comes from the reel; sometimes two thicknesses are opened and twisted into one. Of this it usually takes 30 or 40 feet in length to pack a 6-inch rod, this being wound tight as possible for a foot or so outside the stuffing box. The follower is a "female"—the same inside as the stuffing box, but not so deep, and is sometimes packed with one turn of cotton rope.

The stuffing box is made as "Easy Way" describes, and is packed with one turn of cotton rope; then a piece of thick sheet rubber, say $\frac{3}{8}$", is fitted in around the wall of the stuffing box, the ends butted together. The space inside is now packed with hemp even full; the coil of rope packing before mentioned is placed on top and screwed up, but most of it remaining outside, is tightened up as it is required. I have packed rods in this way at New Orleans, and made the round trip to St. Louis and back, and they were apparently good for another trip, though we never risked it a second trip; whereas the same rods, packed the old way without the rubber, would have to be packed two or three times on the up trip. This is owing to the spring of the timbers, as "Easy Way" explains.

The old fashioned pendulum pumps, with A frames described by "Easy Way," were discarded long since—before my time—the doctor engine taking their place; and although "Easy Way" speaks disparagingly of one bad specimen, they are marvels of efficiency, and are used on all western boats, except very small ones. The nigger engine is about 6" or 7" cylinder by 12" stroke, vertical, placed in the forecastle, and is used to hoist freight and to work the capstan in pulling the boat in at the wharf, and in sparring. The engineers of Western steamers are, as a general rule, the most careful men I have any knowledge of, and although many explosions have occurred, I think it was not in consequence of carelessness. Few outside of the craft have any idea of the difficulties they encounter. The mud alone, in the Mississippi, would discourage any other engineer, to say nothing of the terrific currents they have to overcome, and the high pressures they are compelled to carry.

A series of experiments was made by Mr. James McBride, of Pittsburg, a few years since, on the steamer Arlington, by which it was found that the consumption of coal was 4 pounds per H.P. per hour. If Mr. McBride will please furnish a complete set of drawings with detailed description for publication of the usual type of steamboat machinery, he will much oblige

Brazil, Ind. FORTY NINER.

An English Machinist's Observations.

A little sharp criticism of our faults by foreigners is sometimes useful, even though greatly exaggerated in some particulars. An English machinist who has been in the United States long enough to learn something about our peculiarities, writes a letter to some of his friends at home, the following extract from which we copy from *Capital and Labour*:

"There has been a great exodus from England of men in the engineering trade to this country the last two years. England will have nothing to fear if she only makes a good and useful article with as much taste as utility will allow, make her workmen general and expeditious, and keep to the five years' apprenticeship. The American workmen care very little for serving more than two or three years at a trade. They are shifty and impatient, and they don't care to learn dirty trades. Our mechanics of good skill invariably march before them through their good steady training, and the men are jealous of Englishmen taking the good pay in the shops. There is more scamp and jerry work here than in England. They are a dollar-loving people. They are very smart in woodworking machinery, but they are continually importing men from England to teach them points connected with the manufacture of articles. They are great protectionists. They believe their country would be swamped with English goods, and reduce their pay, and demand for their skill, but the workmen get a poor share of the benefits of protection. They are pushing hard to gain markets for their manufactures. They notice the least thing that is said or done in any part of the world affecting their interests. They are extremely jealous of England. The combined press of the nation is always sneering and writing in depreciatory terms of the country. They failed to find any more liberty here than you enjoy in England. The largeness of the country and its undeveloped state, yielding abundance of food, give it the advantages. Ten hours per day are worked in this country, and the money averages about $2\frac{1}{4}$ to $2\frac{1}{2}$ dollars per day in most trades, with higher exceptions. Many of the English who come here find employment, but they do not become a deal richer; they have to work six hours per week longer; many things are 50 per cent. higher in price; clothes are dearer and not so durable; employers are not one jot more considerate than English ones; and there is plenty of red tape in large firms. The workmen, I think, go to work more cleanly than in most parts of England, and one great good in the shops is, they supply places for men to wash themselves before leaving, in their own time, which is a thing they could establish very well in England, but they have no Saturday afternoons. There is not the recreation, nor is there the fidelity or good sense which exists amongst the English. There are no Government Savings Banks, and the Post Office is not so well managed. Plenty of workingmen have lost 200 or 300 dollars in banks here. Men of position do not mingle with the people for their elevation as in England. There is plenty of poverty in New York, and there is the West-end and the East-end. There are plenty of servants who wear liveries, and they have more titles than most people. Everybody seems to be a Colonel or a Professor. There are poorhouses and tramps in profusion, and men grow richer than in England.

Report of Committee Appointed by the Master Car Builders' Association.

"To Investigate and Report on the Present Construction of Screws and Nuts used on Cars; and the Amount of Accuracy that it is Desirable to Secure and the best Means of Maintaining it in the Standard Adopted by the Association in Richmond, Va., June 15, 1871, and to Draw up Communications Addressed to the Managers and Superintendents of Railroads, Showing the Necessity for the Use of even Sizes of Screw-threads, and the Amount of Saving, as near as it can be Estimated, which will Result to the Roads by strictly Adhering to this Practice."

Your committee regret that they can do little more than repeat what they reported to you last year. At that time a member of your committee made the following verbal statement:

"At the last meeting, you remember that our committee was instructed to prepare a circular urging the adoption of the Franklin Institute standard for screw threads. After that resolution was passed, the committee examined into the matter and found that some discrepancies existed as to the manner of manufacturing taps and dies. It is an illustration of the extreme difficulty of introducing a standard of any kind whatsoever, unless there is some sort of a record in the form of specifications or gauges—some ultimate standard of reference. You may all know that the Franklin Institute standard was proposed by Mr. William Sellers, of Philadelphia, and was first adopted by the Franklin Institute. The standard specifies certain things, among them the diameter of the screw and the angle of the thread. When manufacturers commenced making those taps and dies, some sets of gauges were made by a man named Fox, in the city of New York. Those gauges were distributed around, and the Morse Twist Drill Company procured a set of them, and worked according to them. The Pratt & Whitney Company, of Hartford, when they commenced making taps and dies, undertook to work as nearly as possible to a true inch, and for that purpose procured a set of Whitworth gauges from England. When the Erie Railway undertook to introduce standard screw threads, they found that when they took a nut from one manufacturer, and attempted to screw it on a bolt of another manufacturer, it would not go on. This led to the discovery that there were differences in the taps and dies of the different manufacturers of the country. This coming to the attention of the President of the Association, it was decided to ask Mr. William Sellers to come to the rooms of the Association, and make a statement in regard to the matter. Mr. Sellers did that, and, I think, was surprised to find that such discrepancies existed. The next thing was to induce the manufacturers to come together and try to reconcile their differences, and at this time the Morse Twist Drill Company and the Pratt & Whitney Company are engaged in a most thorough investigation of the subject. The committee did not feel justified in preparing such a circular as they were instructed to, so long as these discrepancies existed among the manufacturers of taps and dies. But in a very short time those discrepancies will be reconciled, and we shall have a standard by which we can be guided, and I would suggest that the committee be continued another year."

Since then the same member of your Committee who made the above statement has visited the Pratt & Whitney works at Hartford, and there learned that the whole work of constructing standard gauges has been assigned to that company, and that for the past year, or longer, they have diligently been at work on the machinery and instruments for making them. To show the difficulties which must be met when exact precision is aimed at, it may be of interest to state that their first step was to procure one or more standard yards, that is, metal bars exactly a yard long. These they procured, as nearly of the correct length as it was possible to obtain; they were taken or sent to those persons who it was thought had the most exact means of measuring them, when it was found that the measurements of no two of these persons of the same bar, nor no two of the bars were exactly the same. It then became necessary to have a standard yard verified in London, next to make a machine to measure and subdivide it. Persons not acquainted with the difficulty of attaining any high degree of precision in measurements can have no idea of the amount of labor involved in doing it. Let it be sufficient to say here that the Pratt & Whitney Company have employed a number of the most expert persons they could obtain to do this work, who have been constantly employed on it at a very heavy expenditure of money, and their task is not yet completed. Besides a machine for making linear measurements, instruments had to be constructed for measuring the angle of the threads and their pitch. Having advanced thus far there would be little trouble in making correct cylindrical gauges, but they found that in order to get at the size of a screw with any precision, it is necessary to measure it over the sides of the threads.

There is no difficulty in making a correct steel screw gauge which is not hardened, but such gauges would soon be worn, and then would no longer be correct. It, therefore, became necessary to devise a process by which they could be hardened, and then ground to the correct size. This has been done, and the Pratt & Whitney Company expect to be able to supply screw and other gauges within six months which will be nearer absolutely correct sizes than any which have ever been made. In fact, this company expect when their instruments and machines are completed, to attain a higher degree of precision in measurements than has ever been reached before, and it is confidently expected that their measuring machines (they are making two, one to go to Cambridge) will be the most exact instruments of the kind in the world. The work which they are doing will, in fact, be a great step in advance in the science of exact measurement, and will, when it is completed, make a much higher degree of precision in mechanical construction possible than has been attainable heretotore. To the Pratt & Whitney Company great credit will be due for undertaking this work and carrying it through in so thorough a manner and at so great an expense. This association will also have the satisfaction of knowing that through its efforts the manufacturers of tools of precision were led to undertake this work, as it was the car builders who originally called the attention of the manufacturers of taps and dies to the discrepancies in the sizes of such tools made at the different establishments.

The facts as related lead your Committee to ask to be continued for another year, as they feel confident that before the end of that time they will be able to perform the duty you have assigned to them more satisfactorily than heretofore, and that the gauges of the Pratt & Whitney Company will make it possible to establish a standard "of the amount of accuracy desirable in screws and nuts," with a degree of precision which thus far has not been practicable.

JOHN ORTTON,
M. N. FORNEY.

Newly Incorporated Companies.

CONNECTICUT.

The New London Silk Weaving Co., New London; Capital, $5,000. For weaving, dyeing and manipulating silk, cotton and other fabrics. A. S. Washburn, Henry P. Gray and John Gray, incorporators.

New Haven Car Trimming Co., New Haven; Capital, $10,000. To manufacture and deal in car findings and trimmings. L. G. Tillotson & Co., Jas. Graham & Co., David Cory and R. E. Goodrich, incorporators.

PENNSYLVANIA.

The Anthracite Powder Co., Ashland, Pa.; Capital, $25,000. Manufacturing Powder. Michael Garner, L. A. Riley, Wm. H. Bright and others, incorporators.

Chemical Pulp Co., Stroudsburg, Monroe Co., Pa.; Capital, $100,000. Manufacturing wood pulp and paper. R. S. Staples, M. L. Keen, C. B. Staples and others, incorporators.

Charteers and Youghiogheny Railroad; office at McKee's Rocks, Allegheny Co., Pa.; Capital, $450,000. J. E. Schwartz, Edward Gregg, Thos. MacConnell, Jr. and others, incorporators. P. O. address, Pittsburgh, Pa. To construct a railroad from Sodom, on the Pittsburg Southern Railway Co., to Latrobe, Westmoreland Co., a distance of 45 miles.

ILLINOIS.

Woodmanse Windmill Company. Incorporators are—Charles D. Knowlton, D. A. Knowlton, and Harrison Woodmanse. Capital stock, $20,000. For the manufacture and sale of wind mills, wind engines, pumps and other machines, and articles for domestic and agricultural purposes. Location, Freeport.

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NEW YORK, JULY 2, 1881.

CONTENTS.

PAGE.

A New Steam Pump 1
The Superior. By E. D. Leavitt, Jr. 1, 2, 3
Investigations Concerning the Graphite Pyrometer 3
A Brief Treatise on the Steamboat Cam. By Lewis Johnson 4
Letters From Practical Men—Experiments with Super-heated Steam—Notes on Mechanical Drawing—Cushion and Counterbalance—Points in Green Sand Moulding—Keys for Pulleys. A Paper for Apprentices—Figured Dimension Drawings—Pitch Circles—The Mississippi Steamboat 5, 6, 7
Report of Committee Appointed by the Master Car Builders' Association 7
Newly Incorporated Companies 7
Annual Convention of the Railway Master Mechanics 8
Trade Myths 8
Master Car Builders' Convention 9
Literary Notes 9
Questions and Answers 9
Manufactures 9
Machinists' and Engineers' Supplies 10
Iron and Metal Review 10

The printed date on each wrapper shows the time to which the subscription is paid. We discontinue the paper in all cases when the time paid for has expired, unless renewed.

Annual Convention of the Railway Master Mechanics.

The American Railway Master Mechanics Association is a body of men whose proceedings at each annual meeting are of great practical interest to artisans in metal throughout the country. These proceedings, for the most part, take the form of reports of Committees and animated discussions of those reports. The fourteenth annual meeting was held at Providence, commencing June 10th, and was attended by about seventy-five members and a good number of visitors, being the largest of any of its meetings for several years past. The address of the president, James N. Lander (of the Northern R. R. of New Hampshire) so well outlined the connection of the Society with recent railroad progress that we make the following copious extracts :

The period during which this association has been in existence has been one of great importance to the railway interests of the country; and I think we can, with fairness, claim for this body a goodly portion of credit for the present prosperity of our general railway system. It is certain that but for the important matters introduced, in consequence of suggestions emanating from our own and kindred bodies, the present rate of transportation would be impossible without doing business at a loss; and as a result we are enabled to transport freights from the grain fields of the far Northwest, two thousand miles from tide water, and supply the markets of Europe with breadstuffs at a profit to the producer, and at a reasonable cost to the consumer. Many changes and improvements have contributed to this result, a part of which can be directly traced to the investigations inaugurated at our annual conventions. The introduction and use of steel for rails, locomotive tires and boilers has effected much toward solving the problem of cheap transportation, and it will be remembered that this subject received our earnest attention in the early days of our organization, and our conclusions have been fully sustained by subsequent events.

Steel rails have enabled us to use large locomotives and heavier and stronger cars, so that carloads have been doubled in weight, and the cost of operating largely reduced, especially in the freight traffic department. Steel tires have also done their part in promoting economy and safety in railway management. It has been practically demonstrated that steel tires properly secured to the wheels of a locomotive are almost absolutely safe; and the few breakages that do occur can generally be traced to faulty workmanship, and almost exclusively to excessive shrinkage. The question of the superiority of steel to iron for the tires of driving wheels for locomotives we may consider as settled, and yet in the infancy of our association it will be remembered that committees were appointed, who gave the matter the fullest investigation in its then undetermined state, and the discussions elicited may be turned to with an interest greatly enhanced by the marked advance of the past few years. The displacement of iron and copper for locomotive boilers, and the introduction of steel, were only effected after the most painstaking investigation and repeated experiment, and manufacturers, awakened by the agitation to its importance, have aided by scientific research, until they have succeeded in producing a steel that is universally admitted to be far preferable to any other material for this purpose. As a consequence, locomotive boiler explosions are now almost entirely unknown, whereas formerly they were of comparatively frequent occurrence.

Another outgrowth of our inquiries and examinations has been the steady increase of the locomotive engine in size and capacity. At the time of our organization, only thirteen years since, the recognized standard engine had cylinders 16″ x 24″; four complete driving wheels, with a weight of thirty tons, and from this the standard has been enlarged until we now have cylinders of 20″ x 26″; eight complete driving wheels, with a weight of fifty tons; and these magnificent machines are now in use in all parts of the country where there are heavy grades to overcome for a large traffic. The rapid and constant improvement in this respect has been so marked that we may confidently expect still further progress in the future; and it will be our mission, as in the past, to assist this development by continued research, and thus add to the welfare of our immense and unparalleled railway system.

The prosperity which now attends us is a matter for congratulation, and yet we have been taught valuable lessons by the "hard times" which have been experienced during the last decade of years. Perhaps not otherwise would economical measures have received so powerful an impetus and been fostered by such powerful and anxious attention. Let us hope that the habits of frugality and thrift thus established may not be disturbed by the spirit of speculation which is again making itself felt in the business world. A continuance of our discussions with the same disposition towards mutual assistance which has always characterized them will encourage and perpetuate the ideas of retrenchment upon which so much of our prosperity depends, and this without regard to the methods by which the various subjects are presented for our consideration.

Seventeen members have been added to the Society within the past year, making the present membership 197. Their financial exhibit shows a healthy condition; no debts, and over seven hundred dollars ahead.

The "Committee of Research in Boiler Construction and Improvement" presented some facts and conclusions on different forms of riveting.

This report states that there are three kinds of riveting; set riveting, called button-set riveting, steam riveting and hand riveting. Mr. Wells, Chairman of the Committee, pointed out the superiority of button-set riveting, and recommended its substitution for the two other methods.

He claimed that this mode of riveting is more economical and much superior to draw riveting by hand, while the work is equal to that done by steam, and therefore this is the better way for establishments that do not use steam for this purpose.

The substance of Mr. Wells' report was able, and sums up the matter as follows:

"It seems to me that the plan of set riveting, owing to its cheapness, and the expedition in doing the work, should receive more attention in the way of carefully-made tests as to quality of the work done by it and the cost for labor than has heretofore been given to it, and it is with the view of calling attention to the plan that this report has been written. Steam riveters drive from 30 to 60 rivets per hour, depending on the machine, the character of the work, and the way it is managed, and the cost for labor of the gang driving the rivets varies accordingly from 1.1 to 3 cents per rivet. A gang of men driving rivets by the set-riveting plan will average about 26 rivets per hour, taking the whole boiler, at a cost of labor of 2.64 cents per rivet, and to drive them by hand a gang of men will average about 12½ rivets per hour for the whole boiler, at a cost for labor of 5.84 cents per rivet."

The shape given to the head is a cone, the sides of which form an angle of about 60°; the top of the cone being removed. This reduces the diameter of the head without weakening it. There is an erroneous idea existing widely among boiler makers, that a large diameter of head is required, but Mr. Wells' experiments proved this to be erroneous.

The set used by this gentleman, unlike the steam riveter, draws the edges of the head down close to the sheet, just sufficient length of rivet being allowed to fill the holes in the sheets and set. Steam riveting was described as being expensive in first cost, and was only economical where large numbers of boilers are built. The tools used for set riveting are few and simple, consisting of a set weighing 3½ lbs., an iron for holding on, which weighs about 60 lbs., and the top of which is recessed to fit the head of the rivet. The rivets are driven by smart blows with sledges, weighing 9lbs. to 10lbs. each. The specimens of riveting exhibited by the methods referred to were driven under circumstances usually existing in boiler making, and they showed that in the case of hand riveting the rivets did not fill the hole; with steam riveting they filled better, but (as was generally acknowledged by the gentlemen present) by the set riveting the holes were entirely filled, the sheets drawn tightly together, and the edges of rivets well closed upon the sheet. Several gentlemen present had used set riveting, with success in every case. The cost was said to be about one-half that of hand riveting, as well as a saving in time occupied in performing the work.

R. H. Briggs, of Whistler, Ala. (Mobile & Ohio R. R.), stated that he had built an experimental boiler, 14″ diameter and 3 feet long. One-half of the longitudinal seam was hand riveted, while the other half was set riveted. After this the boiler was subjected to a hydraulic test, which resulted in pulling the heads off the rivets driven by hand, while those driven by the set remained intact.

The same result was obtained by several successive tests.

Much opposition to set riveting is expected from the hand riveters, who will, perhaps, think that unskilled labor will be employed to take their places.

All present at the Convention concurred in acknowledging set riveting to be a revolution in boiler making, and that it should have the encouragement of every master mechanic.

A report from Jacob Johann, of Springfield, Ill. (W. & St. L. R. R.), on a comparison of the merits of certain methods of forms and bracing of straight-top and wagon-top boilers, also the relative advantages and disadvantages of the two styles, was read by the Secretary, Mr. Setchel.

Although the report contained little that was new, the discussion developed a number of practical suggestions.

Mr. Briggs, in the course of miscellaneous discussion, called attention to the extreme necessity of the adoption of one of the existing wire gauges as a standard, as many mistakes occurred in consequence of the variation in gauges. A committee was appointed to choose the proper gauge, and report at the next meeting. A committee was also appointed to report upon a question proposed by the Secretary, viz., "Is the present system of running locomotives the most economical?" Mr. Setchel favored a contract system, and some of the other gentlemen a premium system. The committee will probably decide which it ought to be, after a full investigation.

The RensselaerPolytechnic Institute, Troy, N. Y., which is the oldest technical school, and has graduated more civil engineers than any other in the country, holds its Commencement exercises for 1881 this week, as we write, beginning with a sermon on Sunday, June 12, and closing Wednesday evening, June 15th. A prominent feature of the week's programme consists in the Alumni Association Reception on Tuesday evening, June 14th. On this occasion short addresses from members of the Alumni are expected, detailing facts of interest relating to their work, and outlining plans and suggestions for the future of the Institute.

Perhaps the matter of most importance which could engage their attention would be the suggestion that the Institute enlarge its borders, so as to make instruction in mechanical engineering and an experimental machine shop, recognized features. The wider scope thus afforded might be reasonably expected to lead up to larger endowments and greater usefulness.

Trade Myths.

There is one thing that every designer of machinery should bear constantly in mind in bringing out anything new, and that is that no machine can be said to be well or completely built until it is sold and remains sold. The drawing room or shop, which is run entirely from the mechanical point of view, is seldom really successful, the dollar-and-cent test being to a shop or machine very much what eating is to a pudding.

But there is a class, and a large class of salesmen (some are proprietors and some hired) who somehow seem incapable of putting their wares squarely on their merits in approaching a customer. By magnifying some trifle or irrelevant circumstance, or attempting to lead off on a false scent, by means of some story that would be immaterial to a right-thinking purchaser, even if true, they manage to befog matters so that the sale, if made, is either made on a false basis, or because the customer takes the bit in his teeth, and decides to make the purchase anyhow for private reasons, wholly apart from the simple and easily-ascertained question of merit. Many a man in this way is accounted a good salesman, whose sales really make themselves, and sometimes do so in spite of him.

The Western salesman, whose chief argu-

ment in approaching a customer was, first, that he had the honor to represent the firm of P. & G., and that there was only one richer man in the State than P., and that was G., may not have exaggerated in either case; but whether mythical or true, that line of argument did not necessarily prove that the goods manufactured by the firm with which he was connected, were best adapted to the wants of even those buyers whose orders were given because of the comparative financial standing of his principals. In general, it may be safely taken for granted that the salesman who habitually prefaces the presentation of his claims with the carefully elaborated statement that his company declared such and such a dividend last year, or that his firm and Governor This or Senator That are cousins or brothers-in-law, or that the firm have in their factory the largest belt in the world, or that their water power runs beer on certain days in the year, or that they own a mine, or expect to discover a process which will enable them to revolutionize almost every known conclusion in iron or steel manufacturing, would probably sell more in the end, if he confined his attention to plain essentials in an agreeable and frank way, leaving fiction to the novelist, and individual gossip to the society papers.

Master Car Builders' Convention.

The fifteenth annual convention of Master Car Builders' Association was held in New York city, June 14th, 15th and 16th. It was attended by over a hundred members, and excited a great deal of interest.

The committee on Standard Oil Box and Bearing, which had acted conjointly with a similar committee of the Master Mechanics' Association, submitted a report recommending that no alterations in the existing standard should be made, which would prevent new parts from interchanging with old, and *vice versa*. Some defects in the bearing, box and pedestal, however, would be easily remedied without interfering with the interchangeability of these parts. These were of no great moment, and were agreed to. The President, Leander Garey, called attention to the necessity for adopting common standards for car work; and, although progress in that direction had been very slow, he assured the members there was no need of becoming discouraged. He recommended that a particular kind of iron should be specially prepared for the manufacture of coupling links and pins, in view of the many accidents that had been caused by them when made of poor material.

One of the most interesting committee reports (in the results aimed to be accomplished) was that upon the prospective adoption of a standard for screw threads and nuts used on cars. This we publish on page 7. It is to be hoped that the expectations of that committee will be realized, and that by the production of accurate gauges a standard system of screw threads will be made not only possible, but an established fact.

Literary Notes.

A new pocket map of the San Juan (Colorado) mining region has just been issued by Geo. H. Adams & Son, as the latest addition to their list of new and valuable geographical and geological works. It is drawn on a scale of half an inch to one mile, and represents about everything in the territory covered that could well be placed upon a map. It gives the new local names of towns, mountains and gulches, locates the new railroads and stations, also projected railroads, stage routes, wagon roads and trails. In looking over the map we cannot help noticing a change from the old California and Dakota miners' nomenclature, for there is no place in this region named after his Satanic majesty, or his particular dwelling place (Hades in the new revision). The map is well executed, and sells for $1.50, postpaid.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(1) J. R. C., Gloucester City, N. J., asks: 1. Is there any special style or feature adopted in the construction and working of the small river screw tug boats—if so, what are they? *A.*—The engines are generally single, vertical and high pressure. Low pressure surface condensing engines have been, and are being introduced with good results. The slide valve is operated by a link which is used both as a cut-off and for reversing. 2. Do engineers require Board of Trade Certificates in this as in other countries—if so, where obtained and what is the cost? *A.*—Licenses to run marine engines are required by the United States Government and are obtainable from the local inspectors of steam vessels for the district where you wish to act as engineer. The price for an ordinary engineer's license is $10. 3. Are there any particular qualifications requisite in an applicant for certificate—if so, what are they? *A.*—Yes; he must be able to give a practical explanation of the operation of a steam engine and boiler, and the manner in which he would handle them under ordinary circumstances; also under certain named contingencies which are likely to occur in ordinary practice. He must also understand the elementary laws appertaining to heat and combustion. 4. What is the average pay of engineers per month? *A.*—The pay of marine engineers varies from $50 to $90 per month according to circumstances.

(2) T. H. M., Erie, Pa., asks: Would you inform me as to where and how I can obtain a cut or drawing of Mr. B. T. Babbitt's (the great soap manufacturer) rotary steam engine, mentioned in your issue of December, 1878; also, what the cost will amount to? *A.*—Write to the Patent Office Department at Washington inclosing the name of inventor, also the name and number of invention, which may be obtained by an examination of the patent office reports. The cost of patent copies is 25c. or 10c., according to the number desired. If you do not wish to follow the above course write directly to the inventor.

(3) Q. B., Chicago, Ill., asks: How much horse power will a double 12″ belt transmit running upon two 30″ pulleys, the driving shaft running 150 revolutions per minute? *A.*—If in good condition from 18 H. P. to 20 H. P.

(4) Locomotive Engineer, Vicksburg, Miss., writes: I am running a locomotive, the steam packing of which is almost continuously making a rasping noise, somewhat like that produced by filing a piece of sheet iron held in a vise and projecting too far from the vise jaws. This noise is worse when working with a light throttle, but when pulling a heavy train, it almost disappears. The piston is solid, with cast iron packing rings, sprung over into grooves. The engine has one guide bar with gibs adjustable by liners. Engine runs backwards and forwards, and is never turned around. Have tried beeswax, plumbago, cylinder oil and tallow without obtaining satisfactory results; tallow giving the best. Please tell me what is the matter, and suggest a remedy that will not require too much work. Have no repair shop. *A.*—We take it for granted that the trouble is with both cylinders, although you do not say so, and may be caused by using too wet steam in the cylinders. This you can determine by trying the engine with a full boiler, and then with a moderate supply of water. The trouble may also be caused by the parts being out of line, which would increase the friction and cause the rings to cut. This can be ascertained by taking off the front heads and examining the cylinders. You can also tell if the parts are out of line without removing the pistons, by pulling the packing out of the stuffing boxes of the piston rods, then put the crank upon the back center. Take a pair of calipers and measure from guide to the piston rod, close to the cross head; then test in the same way close to the stuffing box, making allowance for the lost motion between the cross head gib and guide. After testing both sides in this way, measure with a pair of inside calipers from the bottom of stuffing box to the piston rod at each end of the stroke, which will prove whether or no the guides are in line with the cylinders. If these tests reveal no fault, you will doubtless find the difficulty caused by the rings. If the rings are made of the same kind and quality of metal as the cylinders, there is danger of the rings seizing or clinging to the cylinders so as to create an excessive friction, grinding or cutting the cylinders away. In this case a new set of rings must be substituted. If the cylinders are soft, the rings should be hard; and if the cylinders are hard, the rings must be soft. We have known cases where the trouble last referred to was experienced with valve seats, and the remedy here prescribed was resorted to with very satisfactory results.

(5) B., Meadville, Pa., writes: I have an engine driving a saw mill. The cylinder is 14″ diam., 16″ stroke, cuts off at ¾ stroke or 12″. Has a piston speed of 560 ft. per minute, (210 revolutions). The boiler is tubular, 72″ diam., 14 ft. long, and is placed 5 ft. from the engine. Diam. of steam pipe 3½″. We carry 80 lbs. pressure on the boiler. Please give me the actual horse power of engine, based on above. It is too far out of the way to have it indicated. *A.*—About 45 H. P.

(6) W. W. S., Chicago, Ill., asks: Which will conduct the greater volume of water, viz., a pipe 16″ in diam., and 1800 ft. long to a pump that has a greater capacity than the pipe, or the same pipe having a syphon near the pump flowing into a well under a head of 23 ft. *A.*—The pipe which connects with the pump direct will deliver the greatest amount of water.

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Special Notice.—Owners and managers of large establishments throughout the country will find information of positive value in our 75 page illustrated pamphlet, entitled "Useful Information for Steam Users." It contains data on the care and management of Steam Engines and Boilers and Rules for Engineers and Firemen. Sent for 25c. in P. O. Stamps. The J. N. Mills Publishing Co., 165 Broadway, New York City.

Special inducements offered to clubs. "Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. Less than 5 copies, $1.50 by mail, each, postpaid. American Machinist Publishing Co., 96 Fulton Street, New York.

J. C. Hoadley, Engineer and Expert, formerly of Lawrence, Mass., has opened an office at 29 High St., cor. Federal, Boston, Mass., where he will be pleased to receive old and new friends.

A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price, $2.00. Mailed by E. & F. N. Spon, 446 Broome St., New York City, on receipt of price.

MANUFACTURES.

A carriage bolt manufactory and a woolen manufactory will shortly be started at Ashtabula, O.

The Penn Hardware Works, Reading, Pa., are about to erect large additions to their foundry and to build a machine shop 30x100 feet.

Jerome Wheelock, Worcester, Mass., is building some large engines. He has about 25 in process of construction at the present time.

Whiteley, Fassler & Kelley are building the largest shops in Springfield, Ohio, for the manufacture of reapers, mowers and self-binders.

The Ohio Grindstone Company, of Cleveland, are now operating thirteen large quarries of Ohio sandstone with a force of about 700 men.

Frick & Co., are moving to their new works at the west end of Waynesboro, Pa., on B. & C. V. R.R. and M. A. R. R. Over 400 men are employed now.

The Chicago Die and Machine Works have recently ordered a large quantity of new machinery, which will double their present capacity.

The Meriden Britannia Co., of Meriden, Conn., are building a new extension to their factory, which when completed will be 420 feet long and four stories high.

Capt. Daniel Jones, of the Cambria Steel Works, Johnstown, Pa., is in Colorado, prospecting for new works, a corporation having been organized to build new steel works at Pueblo.

The number of new manufacturing establishments in the course of erection in Philadelphia at the present time exceeds that of any former period in the history of the city.

Mr. C. A. Bauer, the able and efficient superintendent of the Champion Bar and Knife Co., Springfield, O., has also been chosen superintendent of the Champion Malleable Iron Co., of the same city.

The Wiley & Russell Manufacturing Company, of Greenfield are extensively repairing the old cutlery shops, whither they moved some months since, to give more room for their business.

Wilder & Co., manilla paper manufacturers of Ashland, N. H., are building a new mill 120 x 80 feet, with two wings 30 x 50 feet, all two stories, on the river side.

The buildings for the Youngstown, O., Malleable Iron Works have been completed, and it is expected the ovens will be in readiness to fill orders by the 1st of July.

Morrison Bros., Ft. Madison, Iowa, manufacturers of agricultural implements, are building a new foundry, blacksmith shop, machine shop and woodworking shop.

Laughlin & Co., Pittsburgh, Pa., who ordered the first Strong's Feed Water Heater ever made, have purchased another of the same make for a 400 H. P. battery of boilers.

Hall's Safe and Lock Company, Cincinnati, now employ more than 600 workmen, and others are wanted. Orders for Hall's safes and locks were never so large and pressing as at the present time.

The people of Ottawa, Ill., desire to call attention to the advantages offered by their city as a location for new locomotive works. They are ready to give 20 acres or more of land as a site, and offer other inducements.

The Peninsular Car Works, of Michigan, are turning out about 15 freight cars a day from the Detroit shops and 8 a day from the Adrian shops. The erecting shop at the Detroit works is to be lengthened out by an addition of 100 feet.

A Whey Sugar Factory is being established at Aurora, O. The sugar is to be for medicinal purposes, and will be formed into tiny pellets. Cleveland parties are at the back of the enterprise.—*Cleveland Trade Review.*

Notice has been given that the Crescent Tube Company, Limited, of Pitsburgh, Pa., has been dissolved, and John D. Scully, Henry P. Ford and Jas. I. Bennett elected liquidating trustees, with power to wind up the business.

The entire property of the old Lehigh Zinc Company, with the exception of a few lots in South Bethlehem, Pa., has been purchased by Messrs. R. & C. A. Heckscher, wealthy coal operators in the Schuylkill region. They will operate the works.

The Augusta (Ga.) *Chronicle* says that the full capital of $900,000 for the proposed Sibley cotton mills in that city has been subscribed, and that it has been obtained without paying a cent of commission to anybody.

The Southern Car Works, of Knoxville, Tenn., organized, on the 3d of June, with a capital stock of $100,000. The works will be in operation in sixty days, and will employ two hundred mechanics. The company already has orders for a year's work.

The Craig Governor for Steam Engines is being favorably received, and has been lately furnished to the following parties: Wm. Taylor & Sons, Brooklyn; Thos. F. Rowland, Continental Iron Works, Brooklyn; E. R. & R. B. Livermore, Middle Village, Long Island.

William Wright, Newburgh, N. Y., is building a number of large compound engines. He is constructing one of 700 horse power for Waterbury's cordage works in Brooklyn, where one of his 450 horse power compound engines has been running for the last three months.

The Smith, Beggs & Ranken Machine Company are making an addition to their works at the intersection of Main and Monroe streets, the cost of which will be about $4,000. As soon as this is ready for occupancy they will largely increase their force of workmen.—*St. Louis Age of Steel.*

The Portland, Me., Stove Foundry Company are to erect three wooden buildings in that city, one, a foundry building one story high with monitor roof and 100x65 feet in size; a workshop three stories high, 100x45 feet in size, and a warehouse three stories high, 100x45 feet in size; and will also put in a steam engine with boiler of fifty horse power.

William Cramp & Sons, the Philadelphia shipbuilders, are about extending their operations to New York. They have leased for the term of fifteen years the Erie basins at South Brooklyn, the largest dry-docks in the United States, and capable of lifting the biggest steamers afloat. These have been lying idle for several years, but are now being put in order by the proprietors for the lessees. In about two months the Messrs. Cramp will take possession of them.

Christopher Lewis, superintendent of the Columbus Rolling Mill, has invented a machine which, if it does the work the inventor expects, will revolutionize work in rail mills. Mr. Lewis expects that the machine, with three boys to run it, will save the labor of 26 men. It consists of seven sets of rolls, through which the iron passes before it comes out, the finished rail or plate with automatic carriage for receiving the metal from one set of rolls, turning it over and starting it through another set.—*Chicago Industrial World.*

The Railway Employes' Mutual Benefit Association of the West recently held its annual meeting in Chicago. It had lost 240 members during the year and had gained 40. Most of the loss of membership was by reason of delinquents. In the eleven years the Association has been in existence $344,000 has been disbursed in benefits. The total receipts of the year ending June 8, were $25,998, including a balance on hand of $2,559, and death assessments of $20,882. This had all been disbursed except $1,339. J. R. Wood, of Philadelphia, was re-elected president. The next annual meeting will be held in Chicago the second Wednesday in June, 1882.

D. Saunders Sons, Yonkers, N. Y., are employing over 60 men in the manufacture of pipe cutting and threading machines and pipe fitter's tools. They are supplying all the leading wrought iron pipe manuturers with their improved machines.

Machinists' and Engineers' Supplies.

NEW YORK, June 16, 1881.

Trade in most kinds of supplies is good, though for small tools it is not very brisk. Foot power lathes are very scarce and dealers complain that they can not fill their orders. There is a probability that with several new manufacturers the trade will be well supplied in the fall. Machinist's tools are very scarce and hard to obtain at short notice. Orders are constantly being placed several months ahead. All kinds of railroad supplies are in good demand at former prices.

Hart & Sloan, of Newark, N. J., are about to introduce a new measuring instrument for machine shops. It will measure to the thousandth of an inch with ease.

H. Prentiss & Co. have removed from 14 Dey St., New York, to 42 Dey St., where they have a warehouse 75x20 feet with a basement of the same size. They intend to carry a larger stock of machinist supplies than ever before.

Iron and Metal Review.

NEW YORK, June 16, 1881.

The pig iron market is surprisingly inactive in the face of the fact that almost all the iron foundries and rolling mills are full of work. There seems to be an over-production, and several furnaces have lately blown out. No immediate improvement can be foreseen. We quote No. 1, Foundry, $24; No. 2, Foundry, $22; Grey Forge, $20; Coltness, $23 to $23.50; Eglenton, $21; Earnbroe, $22; Glengarnock, $22.50, and Gartscherrie, $23.

The rail market is active, but sales are few and in large lots. Steel rails sell at $56 to $60, and iron rails $48 to $50, both at mills. Old T rails are in slow demand at $26, and double heads, $27. No. 1 wrought scrap is not much called for, but is held at $28 to $30 at the yard.

Boiler maker's supplies are in fair demand at the following prices: Tank iron, 2¾c. to 3c.; Refined, 3¼c. to 3⅜c.; Shell, 3⅛c. to 3¾c.; Flange, 4⅝c. to 4¾c.; Fire Box, 5⅛c. to 5¾c.; Burden's Rivets 5 1-10c. Boiler Tubes, 45 per cent. discount from list.

Bar iron from store still sells on a basis of 2.5c. for refined.

The metal market is not booming. Ingot Copper is held at 17⅛c. to 18c. Tin is firm at 20¾c. to 21¼c. for Straits and Billiton; Pig Lead is dull at 4⅜c. to 4½c. for Common, and about 4¾c. for Refined; Western Spelter sells at 4⅞c. and Silesian, 5¾c.; Sheet Zinc, 6¾c. to 7c.; Antimony is active at 14c. to 14¼c.

WANTED

Wanted—A foreman in a machine shop accustomed to first class steam engine work. Apply, with references, to Weeks & Halsey, Front and Pearl Streets, Brooklyn, N. Y.

A mechanical engineer and draughtsman of 25 years experience, both in America and Scotland, and who has a moderate amount of capital, will shortly be willing to take a position in a machine shop as partner, or to co-operate in starting a new concern. Address BOX 14, AMERICAN MACHINIST.

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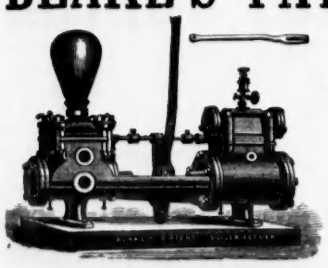

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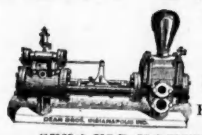

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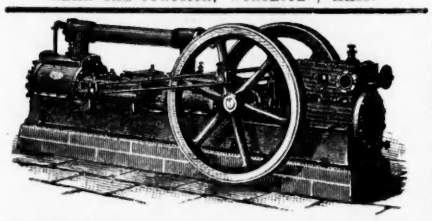

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JAS. D. FOOT, Esq., Waterbury, Conn., Nov. 8th, 1878.
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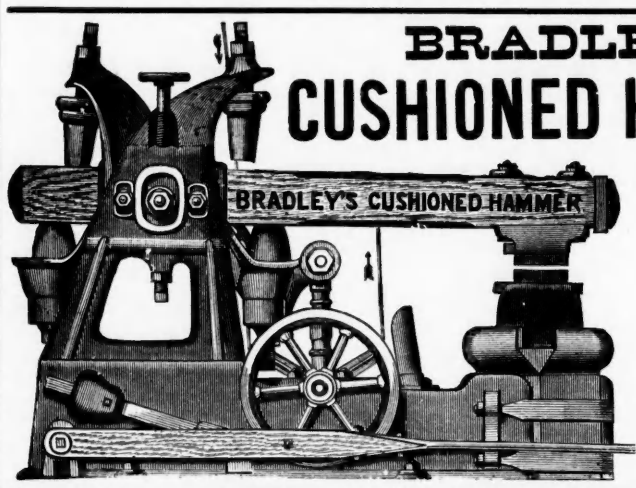

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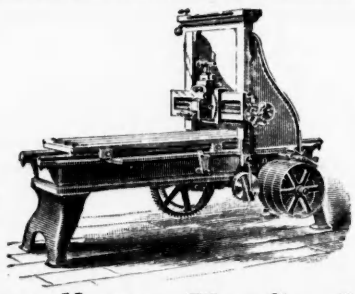

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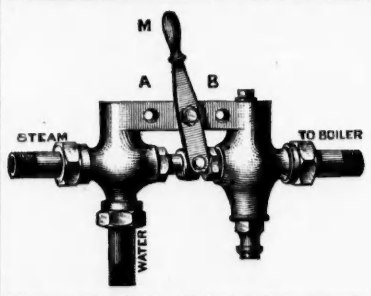

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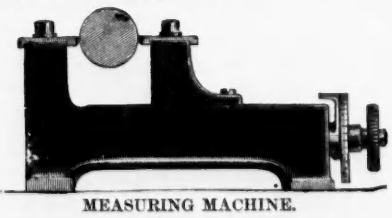

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